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Department of Health and Family Services

DIVISION OF HEALTH

BUREAU OF PUBLIC HEALTH
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October 25, 1997

Tom Wentland
DNR Southeast Regional Office
2300 N. Dr. Martin Luther King Dr
Milwaukee WI 53212

Dear Tom:

I am sending, for your records, a copy of the public health assessment for the Delavan Municipal Well #4 Superfund site. This paper was written for ATSDR to formalize our assessment of the public health risks associated with this site. It contains no new information but rather documents our evaluation as of the time it was submitted to ATSDR in 1995. I also sent a copy of the assessment to Dale Ziege.

Please call Henry Nehls-Lowe at 608/266-3479 if you would like to discuss new information about this site or if you would like additional information about the assessment. If you want to know more about the distribution of this document, please call me at 608/267-6844.

Sincerely,

Mary

Mary Young
Public Health Educator
Section of Environmental Epidemiology and Prevention

26509164O

Public Health Assessment for

DELAVAN MUNI WELL #4
DELAVAN, WALWORTH COUNTY, WISCONSIN
CERCLIS NO. WID980820062
DECEMBER 20, 1996

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH ASSESSMENT

DELAVAN MUNI WELL #4

DELAVAN, WALWORTH COUNTY, WISCONSIN

CERCLIS NO. WID980820062

Prepared by

Wisconsin Department of Health and Family Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

Additional copies of this report are available from:
National Technical Information Service, Springfield, Virginia
(703) 487-4650

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. It was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by a site and recommends ways to stop or reduce exposure in its public health action plan. ATSDR is primarily an advisory agency, so usually these reports

identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

PREFACE: PURPOSE OF PUBLIC HEALTH ASSESSMENTS

The federal "Superfund" law requires the U. S. Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of all toxic waste sites that the U. S. Environmental Protection Agency (U.S. EPA) proposes for inclusion on the list of the nation's most hazardous waste sites. This list formally is called the National Priorities List. The Wisconsin Department of Health and Family Services works with ATSDR to prepare these health assessments. The purposes of public health assessments are:

1. To evaluate whether contaminants at the site pose a current or future threat to public health;

2. To recommend any steps needed to protect the public from exposure to toxic substances; and,

3. To recommend long-term health studies, when appropriate.

In preparing a public health assessment, health professionals examine all contaminants present, including each chemical's toxicity; ability to move through soil, water or air; persistence in the environment; and ability to accumulate in the food chain. They look at ways that people could be exposed to contaminants, including eating, breathing, or touching the chemicals. When necessary, relevant health records are investigated to determine whether anyone has been affected from exposure to contaminants originating from the site. Finally, the public health assessment identifies the health hazards that a site may pose and recommends action to protect public health now and in the future.

The Wisconsin Department of Health and Family Services and ATSDR conduct a "preliminary" public health assessment after the U.S. EPA proposes to include a site on the National Priorities List. The "Preliminary" public health assessment relies on data available prior to the Remedial Investigation. It also can identify and recommend sampling to be addressed by the Remedial Investigation, which is conducted as part of the Superfund clean-up of the site. Following the completion of the Remedial Investigation the "Full" public health assessment is completed, which incorporates the data collected from the investigation. The U.S. EPA and the Wisconsin Department of Natural Resources provide much of the sampling data used for the assessment.

SUMMARY

Groundwater in the Delavan area is contaminated with VOCs (volatile organic compounds). This VOC contamination was measured in Delavan municipal water, from 1983 through 1993, but is not an apparent public health hazard because VOCs were not at levels that pose a health concern. Delavan Well No. 4 is an indeterminate public health hazard for past human exposures to contaminated drinking water. Delavan residents were evidently exposed to municipal water contaminated with VOCs prior to 1982, but it is not possible to determine the level and duration of their exposures. In June 1993, a treatment system came online that removes contamination from the water. Contaminated groundwater is not an apparent public health hazard for private well users in the Delavan area. No Delavan-area homes were identified that obtain contaminated drinking water from private wells. Three Delavan businesses have wells contaminated with low levels of VOCs that are not a health concern.

The full extent of contaminated groundwater in and around Delavan has not been determined and needs to be characterized. Any newly discovered, existing private wells in the Delavan area should be evaluated or tested for VOC contamination. Any new private wells installed in the Delavan area should also be evaluated or tested for VOC contamination.

Ambient air exposure to VOCs from a storm sewer carrying treated water away from Sta-Rite Industries, a nearby manufacturer, is an indeterminate public health hazard. Adequate air sampling has not been conducted inside and adjacent to the storm sewer covers, as recommended in the Preliminary Public Health Assessment for Delavan Well No. 4. Air samples should be collected from inside the storm sewers and at storm sewer access covers to provide data which can be used to more fully evaluate possible human exposures to VOCs in ambient air.

Sediments in Swan Creek, where treated water from Sta-Rite leaves the storm sewer, contained VOCs at levels that are not a health concern. Surface water and sediments in a five-acre pond, located immediately adjacent to the Sta-Rite property, should be tested for contamination. This is a data gap.

Delavan Well No. 4 is one of several municipal wells serving the City of Delavan, located in Walworth County, Wisconsin. In early 1982, Well No. 4 was found to be contaminated with several VOCs, and three months later the use of Well No. 4 was halted. Delavan Well No. 4 was designated a Superfund site in 1984. Sta-Rite was identified as the probable source of the contamination. In 1983, the nearby Delavan Well No. 3 was also found to be contaminated with VOCs, but this well was not removed from service. In 1990, a decrease in contaminant levels prompted the City of Delavan to return Well No. 4 to normal use. To keep concentrations of specific VOCs below Wisconsin groundwater standards, the City was required to blend water from Well No. 4 with water from other wells. In 1993, a new treatment facility began processing water from Wells No. 3 and No. 4, removing all measurable contamination. No community health concerns relating to Delavan Well No. 4 have been reported.

BACKGROUND

A. Site Description and History

Site Description

Delavan Well No. 4 is located in the City of Delavan, Walworth County, Wisconsin, (Figure 1) and is owned by the City of Delavan. Well No. 4 is found within the southeast ¼ of Section 17, T2N, R16E, in the Town of Delavan. This Superfund site is defined as "the contaminated aquifer used by the Delavan Well No. 4" [47]. Delavan Well No. 4 was nominated to the federal National Priorities List in 1983 and officially placed on the NPL in 1984 [33].

The land around Delavan has moderate topographic relief with a gently rolling surface. This area was glaciated during the most recent glacial period. Local soils consist of glacial till, with moraine and outwash deposits. Surface water in the area drains into Turtle Creek, which flows west and enters the Rock River, over 20 miles to the west of Delavan. The terrain in the vicinity of Well No. 4 is fairly flat, and Comus Lake is approximately 5,000 feet to the northwest. The depth to groundwater around Well No. 4 is approximately 35 feet, and the general flow of groundwater in the area is reported to be to the northwest, towards Comus Lake [64, P4.13].

History

In 1981 the City of Delavan municipal water supply system consisted of three high-powered, high-capacity wells, two elevated storage reservoirs, and a distribution network of pipes. All municipal wells drew water from the shallow sand and gravel aquifer. Pumping records from 1979, 1984, and 1987 show that water use for Delavan was 230, 294 and 270 million gallons annually [13] [28]. In 1981, Well No. 4 pumped an average of 12 million gallons per month, roughly one-third of the City of Delavan's municipal water needs. Well No. 4 was constructed in 1968, is 115 feet deep and has a capacity of 680 gallons per minute. In 1981 Well No. 3 pumped a monthly average of 7.4 million gallons (Figure 3). Well No. 3 is 130 feet deep and has a capacity of 680 gallons per minute. One elevated reservoir has a capacity of 150,000 gallons and the second, which is near Well No. 3, has a capacity of 250,000 gallons. A one-million gallon elevated reservoir is planned for construction in a business park east of Well No. 4.

In March 1982, the Wisconsin Department of Natural Resources (DNR) reported that Delavan municipal Well No. 4 was contaminated with five volatile organic compounds (VOCs). This testing by the DNR was part of a first-time U. S. Environmental Protection Agency sponsored survey that examined VOC contamination in 144 community water supplies throughout Wisconsin [24]. One of the contaminants

found in Well No. 4, trichloroethylene (TCE), was measured at 130 μg/L (Table 1). This level exceeded the then state health advisory for TCE of 45 μg/L. Other VOC contaminants were detected in the well water, but all were below Wisconsin health advisory levels in place at that time and not a health concern. Consequently, the City of Delavan halted use of Well No. 4 in July 1982 [33]. This DNR testing also found TCE in Delavan Wells No. 2 and No. 5, but at only trace levels (less than 1 μg/L) [24]. There were no reports that contamination was found again in these wells.

In August 1982, one month after Well No. 4 was taken offline, water samples were collected from taps at the nearby Wileman Elementary School, the Delavan city hall, and the Delavan high school. TCE was not found in these samples; analysis was not performed for other VOCs.

Delavan Well No. 3, located approximately 1,000 feet west of Well No. 4 (Figure 2), was first tested for VOCs in September 1982, and no contamination was found. However, in June 1983 low levels of TCE and another VOC were detected in water samples collected from the well [12]. Since that date, water samples collected from Well No. 3 have frequently shown the presence of TCE and other VOCs.

In March 1984, TCE (at 27 μg/L) was the only contaminant found in Well No. 4, and no contamination was detected in Well No. 3. These changes in contaminant concentrations could have been affected by the changes in pumping rates of the two municipal wells and the clean-up and control of the apparent contaminant sources at Sta-Rite. Between August 1983 and February 1984, there were dramatic changes in the monthly pumping rates of both wells. After February 1984 the pumping rate of Well No. 4 was dropped to a standby basis and the use of Well No. 3 increased. In September 1984, Well No. 3 pumped a reported 22.9 million gallons (Figure 3). It was not until the Fall of 1984 that the first extraction wells on the Sta-Rite property became operational.

The source of VOC contamination in Well No. 3 has not been identified, but Well No. 3 and Well No. 4 may share one or more of the same sources of contamination. Well No. 3, was first tested for VOCs in September 1982, but no contamination was detected. Concern was expressed by the DNR, in July 1983, that major changes in pumping rates of Wells No. 3 and No. 4 could influence the movement of the suspected contaminated groundwater plume(s), possibly resulting in contaminated water being drawn toward Well No. 3.

In 1984 groundwater modeling suggested high pumping rates would be necessary at Well No. 3 to draw contaminated groundwater from the Sta-Rite property [43, P3.3]. Contamination was not found in Well No. 3 until after pumping rates were decreased for Well No. 4 and increased for Well No. 3 (Figure 3). The highest level of TCE detected in Well No. 3 (230 μg/L) was in August 1983, the same month Well No. 4 was

decreased to a standby rate and Well No. 3 was almost doubled above average production levels.

Capture zone modeling on Well No. 3 and Well No. 4, conducted by an environmental consultant, indicated it was plausible for these wells to be drawing contaminated groundwater from some of the same sources [62]. A sampling history of both wells show the presence of certain VOCs (including TCE) with similar variations in concentrations through time.

The City of Delavan halted use of Well No. 4, in July 1982, four months after finding contamination and relied more heavily on water pumped by Well No. 3. Well No. 4 continued to be pumped at a slightly decreased rate (approximately 6.5 million gallons per month), but the water was discarded (Figure 3). After July 1982, the pumping rate of Well No. 3 was increased from 7 to 10.5 million gallons per month. The pumping rates of Wells No. 2 and No. 5 were also increased in July 1982. In January 1984, the pumping rate of Well No. 4 was decreased to a standby rate of approximately 400,000 gallons per month.

The preliminary public health assessment for Delavan Well No. 4 was issued by the Agency for Toxic Substances and Disease Registry (ATSDR) in June 1989 [41]. The preliminary health assessment concluded the site was a potential public health concern because "of the risk to human health caused by the possibility of exposure to hazardous substances via contaminated municipal drinking water from Well No. 4." The document recommended that Well No. 4 not be used to provide drinking water for residents of the City of Delavan, except in an emergency and only if blended with water from other wells. The Site Review and Update for Delavan Well No. 4 was released by ATSDR on September 30, 1993. This update report concluded that the site was an indeterminate public health hazard and recommended that a full public health assessment be conducted on the site [41].

In April 1990 environmental consultants recommended the City of Delavan return Well No. 4 for normal use on an unrestricted basis. The consultant reported a decline in VOC contaminant levels observed in Well No. 4 over the previous few years [15]. This decline was attributed to the removal of contaminant sources or the installation of extraction wells at the Sta-Rite property. Their recommendation was also based on pump test results Well No. 4 which were conducted by the City of Delavan in 1989.

As a result the DNR authorized the City of Delavan to return Well No. 4 to normal use in May 1990. However, the DNR recommended that Well No. 4 be "operated as a lag pump and blended with water from Well No. 3" because TCE continued to be present in Well No. 4 at concentrations slightly below the Wisconsin Groundwater Quality Enforcement Standard of 5 μg/L [30]. Pumping records indicate that Well No. 4 was returned to normal use in late 1990.

Well No. 6 came on-line in July 1993, is over 1,500 feet deep and draws water from a separate aquifer isolated by bedrock from the shallower aquifer used by other city wells. The City of Delavan built a one million gallon storage tank in the Delavan Business Park, 4,000 feet northeast of Well No. 4, and became operational in January 1996. At the site of Wells No. 3 and No. 6 is a 250,000 gallon storage tank, and the City has no plans to replace it in the foreseeable future.

In June 1993 the City of Delavan brought a new water treatment facility on-line that treats water provided by wells No. 3, No. 4, and the new Well No. 6. This facility is located next to wells No. 3 and No. 6. The facility includes a stripping tower for water from Well No. 4, an aeration system for water from wells No. 3 and No. 6, and an iron removal component for all three wells. The Delavan Director of Utilities reported the first tests of post-treatment water in June 1993 showed no detectable levels of VOC contamination.

After the discovery of VOC contamination in Well No. 4 in 1982, the City of Delavan and DNR attempted to identify the source of the contamination [11]. The DNR surveyed ten businesses operating in the vicinity of Well No. 4 to determine which used TCE [25]. Sta-Rite Industries, located east of Well No. 4 and directly across Wright Street (Figure 2) previously reported to the City of Delavan and DNR their historical use of TCE in their manufacturing processes [66].

STA-RITE INDUSTRIES

Sta-Rite (Sta-Rite Industries, Inc.) has manufactured submersible water pumps and other products in Delavan since 1958. In 1990, Sta-Rite was the largest manufacturing employer in Walworth County with 525 employees [56, P4.1] [17]. Operations at the Wright Street Sta-Rite property occur in two buildings: Plant No. 1 was constructed in 1958 and Plant No. 2 was built in 1968 (Figure 2).

Sta-Rite reported use of various VOC solvents in Delavan from 1960 till 1977 [56]. Sta-Rite recycled and evaporated spent solvents; however, the handling and disposal of some solvents apparently resulted in contamination of soils and groundwater under and in the vicinity of the Sta-Rite property. The principal solvent used at Sta-Rite was TCE, though other solvents used included PCE (tetrachloroethylene). TCE was used at Plant 1 as a paint thinner and degreaser from 1960 to 1977 [66]. At Plant 2 TCE was used for cleaning and degreasing from 1968 till 1977 [56, P4.1]. Though Sta-Rite reports continued use of solvents, their use has been decreased and are recycled. Sta-Rite began recycling spent solvents in 1976 [56, P4.4].

The soils and groundwater at both of these Sta-Rite plants were contaminated with VOCs. At Plant 1 a series of floor drains and catch basins were used to collect spilled and spent solvents. Contamination may have entered into the ground through cracks in

catch basins [64, P2.7]. The liquid collected from the catch basins drained into the Sta-Rite storm sewage system, along with non-contact cooling and pump-test wastewater. Prior to 1982, this storm sewer ultimately discharged into an open drainage ditch system. This open drainage system started south of Plant 1, and liquid in it flowed west to the eastern edge of Wright street and south to a marshy area south of Plant 2.

Overflow from the marshy area went through a culvert, under Wright street and into a vacant lot south of Well No. 4. In 1982 Sta-Rite connected their storm sewer system into the recently installed Delavan municipal storm sewer system [61, P2.7], and is currently covered by a Wisconsin Pollutant Discharge Elimination system permit [31]. Since connecting to the Delavan storm sewer, there are no accounts of spent manufacturing solvents being discharged into the Delavan storm sewer because Sta-Rite reports solvent use was decreased and they began recycling spent solvents in 1976 [56, P4.4].

A single sump at Plant 2 received waste liquids. This sump was a series of manhole sections without a bottom section. Liquids emptied into the sump discharged directly into the ground [61, P2.6] [66]. The depth to groundwater under the Sta-Rite facility was reported to be approximately 35 feet below the surface [59, P1.1]. The sump at Plant 2 was identified in 1983 by a Sta-Rite contractor as a likely source of contamination affecting municipal well No. 4 [70].

INVESTIGATIONS AND FOLLOW-UP ACTIVITIES

There have been a number of investigations as a result of the contamination found at the Sta-Rite property. For a complete account of these investigations refer to the original documents or the detailed summary of previous investigations in the Sta-Rite Remedial Investigation Report [64, P2.14].

A report released in early 1983 described VOC contamination of sub-surface soils on and groundwater under the Sta-Rite property, and indicated Plant 2 as a possible source of the contamination found at well No. 4 [64, P2.14] [70]. These contaminated soils were removed in November 1983 [33, P7].

A subsequent investigation in May 1983 was unable to identify the path of contaminants from Plant 2 to well No. 4. The report did indicate a plume of contaminated groundwater was evidently migrating away from Plant 1 and to the northwest, which is the general direction of local groundwater flow [40]. The report concluded that VOC contaminated groundwater near Plant 1 had little to no effect on Well No. 4 [33, P4].

A contractor modeled groundwater contamination at Sta-Rite and described in a 1983 report that up to three plumes are migrating away from the Sta-Rite property. This report concluded Well No. 4 is only affected by contamination from Plant 2, and that

most of groundwater contaminants found at Plant 2 are not drawn by Well No. 4. The report also concluded that contamination from Plant 1 is not being drawn by either wells No. 3 or No. 4, and the contamination detected in well No. 3 is probably not coming from the Sta-Rite property [41, P15]. The DNR raised several issues in response to this report, most notably of the need to determine the full extent of groundwater contamination coming from the Sta-Rite property and how this contamination might be affecting present and future water supplies [27]. An engineering consulting firm working for the City of Delavan also responded to the report and questioned the accuracy and the sensitivity of the model [71].

In 1984 and 1985 seven groundwater extraction wells were installed on the Sta-Rite property [67]. Five wells were installed around Plant No. 1, and ultimately, two extraction wells were installed at Plant No.2. Table 5 describes the PCE and TCE concentrations found in water from each extraction well. Releases by Sta-Rite of contaminated extraction water into surface water has been permitted by the DNR, under the Wisconsin Pollutant Discharge Elimination System. The extracted water, which contains VOC contaminants, is disposed into the Delavan storm sewer. Water from four of the extraction wells (EX-1, EX-2, EX-3, and EX-7) is sprayed into the storm sewer [65, P3.21]. Spraying is intended to hasten the evaporation of VOC contaminants from the water. Water from the other wells is poured into the storm sewer. Sta-Rite is required monthly to collect and analyze samples of extraction well water discarded into the Delavan storm sewer system [31].

An April 1984 report prepared by a consultant for Sta-Rite concluded that contamination affected only the upper portion of the aquifer and contaminated groundwater flowed northwest towards Comus Lake, and because of this reported that "Sta-Rite believes it is not necessary to implement an extensive groundwater monitoring program to define the exact plume boundaries." The report recommended: the installation of a groundwater extraction system to control contaminated groundwater; additional monitoring wells near Plant 1; and a soil flushing and groundwater extraction system near the sump area at Plant 2 [43, P4].

Soils in the sump area, next to Plant No. 2, had elevated levels of VOCs. A soil flushing system was in operation at this location from 1984 till 1988. Water flushed through the soil was discharged into the storm sewer. In May 1988 a vapor extraction system that vents soil gas into the atmosphere was installed here [33, P7].

Pump testing was conducted in 1989 by the City of Delavan on Well No. 4 to evaluate the changes in contaminant concentration during moderate use of the well over 30 days. As a result of these tests the capture zone of Well No. 4 was estimated by an engineering contractor to only include Plant 2. The subsequent report suggested Plant 1 to be "hydraulically isolated" from Delavan Well No. 4 [55].

B. Site Visits

In conjunction with the Southeast DNR District office, two representatives of the Wisconsin Division of Health (DOH), Henry Nehls-Lowe and Chuck Warzecha, visited Delavan on April 13, 1993. The site visit team met with staff from Delavan Water Works, received an overview of the status of the water supply system for the City and the plans to bring the new well and treatment facility online. Leaving the Water Works office, the team passed by the Delavan School for the Deaf located on the west side of Delavan. Students at this school could be a potentially sensitive population to adverse health effects from exposure to contaminated drinking water (see Demographics on page 8). Upon arriving at Well No. 3, the team toured the adjacent, new water treatment facility in the final stages of construction. Next to this facility is Well No. 6, which was scheduled to come on-line within eight weeks. It was noted that Wileman School is immediately south of this location.

After leaving the treatment facility, the team went northwest and onto the 900 block of Ann Street. The DNR has determined that two bulk storage fuel facilities at this location (the former Mobil Oil and Mudlaf/Standard Oil site) have contaminated nearby soils and groundwater with fuel products. Both of these facilities are approximately 500 feet west-northwest of Well No. 3 and are being cleaned up under the authority of the Wisconsin Environmental Repair Statute. In addition to contamination by fuel products, VOCs (including PCE and TCE) were also found in groundwater under and around this site. The site visit team then drove around the Sta-Rite property, noting the locations of monitoring and extraction wells, including Well No. 4 across Wright Street.

DOH received reports that local residents collected drinking water from a spring located on the northwest side of the City of Delavan, adjacent to a cemetery and next to Lake Comus. On April 11, 1995, two DOH staff, Henry Nehls-Lowe and Chuck Warzecha, visited Delavan and collected a water sample from the spring. Laboratory analysis of the sample found trichloroethylene at 6.3 μg/L. Based on this information, the City of Delavan took action that halted use of the spring by removing a pipe that protruded from the ground [22].

A home owner, living less than one-half mile northeast of the Delavan city limits, expressed concern about possible contamination of her well. On July 26, 1995, two DOH staff, Henry Nehls-Lowe and Chuck Warzecha, collected a water sample from this private well. Laboratory analysis of the sample found no detectable VOC contamination [23].

C. Demographics, Land Use, and Natural Resource Use

Demographics

Delavan Well No.4 is in the City of Delavan. The 1990 census determined there were 5,387 residents of Delavan. In 1984 the City of Delavan reported that 1,564 households were served by the municipal water system [13], providing domestic water to an

estimated 4,200 people (assuming 2.7 persons per household). Approximately 94 percent of the population is white, with a median age of 36.7 years, and an average household income of $33,760 [10].

The Baseline Risk Assessment identified five potentially sensitive populations within one mile of the site. This includes a day care and preschool, two private schools, a public elementary school, and a nursing home (Figure 2) [60, P3.1]. Also within the City is the Delavan School for the Deaf, which is operated by the Wisconsin Department of Public Instruction. This school receives its water from the Delavan municipal water system. During the school year approximately 180 students, from 6 to 21 years of age, attend this school. Most students reside at the school from Sunday evening till Friday afternoon and many have multiple handicaps and related health problems [19], which might make them more susceptible to the effects of VOC contaminated drinking water.

Land and Natural Resource Use

Well No. 4 is located in a commercial and industrial area on the southeast side of Delavan. The area surrounding Delavan Well No. 4 is made up of a number of different zoning types, as designated by the City of Delavan. Immediately east of the well and across Wright street is an area of industrial zoning, which includes the Sta-Rite property. Further east of Sta-Rite and north of Highway 43 is a recently constructed industrial park, on which only a few structures were present at the time of the April 1993 site visit. Directly north and northwest of Well No. 4 is a commercial/industrial zoned area with a mixture of light industries located on Ann Street. North of Ann Street is a railroad right-of-way, with residences immediately beyond the track. South of Well No. 4 is a mixed pattern of residential, industrial and commercial properties. Immediately south of Well No. 4 is an apartment building that was constructed in 1962. Across Wright street from the apartment building is a strip shopping mall. Approximately 1,000 feet southwest of Well No. 4 and directly south of Well No. 3 is Wileman Elementary School. One and one-half miles southeast of the site is a dog racing track. Less than 500 feet southeast of the Sta-Rite property is a five-acre pond, where there is evidence that people fish. Fishing and boating are also popular activities on Comus Lake, located approximately 4,900 feet northwest of the Sta-Rite property.

Agriculture is a major activity beyond the city limits of Delavan. Over 65 percent of land in Walworth county is farmland, of which dairy farming is the most significant agricultural activity [17].

In the Delavan area, groundwater is the source of most water used for domestic and agricultural purposes (except for irrigation). Outside of the Delavan city limits, most nearby households obtain water from private wells.

D. State and Local Health Data

"Health Outcome Data" refers to records of death and illness. A review of health outcome data may be appropriate when there is evidence people living near a Superfund or contaminated site have been exposed to hazardous substances at levels which could lead to an increase in rates of death or disease. A review also may be appropriate if there are reports of unusual clusters of disease near the site or due to specific community health concerns.

As discussed later in the Pathways Analysis section, Delavan residents have apparently been exposed to contaminated water pumped by Wells No. 3 and No. 4. However, it is unclear if people were exposed to contaminated water for a duration and at levels that might plausibly result in deaths or illness. The Wisconsin Department of Health and Family Services, Division of Health, has not received any reports of clusters of chronic disease or cancers in the vicinity of this site. The available data systems that could be used to investigate if elevated levels of illness and/or death are discovered include the Wisconsin Cancer Reporting System, the vital statistics records of births and deaths in Wisconsin, and the Wisconsin Birth and Development Outcome Monitoring Program.

COMMUNITY HEALTH CONCERNS

No community health concerns have been received about Well No. 4 by the Walworth County Human Services agency nor the Wisconsin Division of Health.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

Untreated drinking water provided by Delavan Well No. 4 is contaminated with VOCs. This contamination apparently originates from the nearby Sta-Rite Industries. Sub-surface soils and groundwater under the Sta-Rite property contained higher levels of contamination than has been found in Well No. 4. Clean-up actions on the Sta-Rite property removed the sources of this contamination, and ongoing groundwater and soil treatment systems further minimize the movement of contaminated groundwater away from the property.

Available information indicates that VOC-contaminated groundwater may be wide spread in the Delavan area, but the full extent of this contamination has not been determined. Several investigations have not discovered any Delavan homes with private wells that draw VOC-contaminated groundwater, but sampling of private wells at three Delavan businesses found VOC contamination. Additionally, unrelated DNR investigations have found VOC contamination at five other sites located in eastern Delavan. The sources of this contamination have not been identified. One natural spring located near Comus Lake was found to be

contaminated with TCE and the City of Delavan closed access to this spring. The source of this contamination is not known.

There are three bodies of surface water in the vicinity of Delavan Well No. 4 that were possibly affected by contamination coming from the Sta-Rite property. Swan Creek sediments and surface water were found to contain low levels of VOCs that are not a health concern. No contamination was found in surface water samples from Comus Lake. There has been no sampling of sediments or surface water from a five-acre pond southeast of the Sta-Rite property.

This following section describes how "Chemicals of Concern" are distributed in soil, sediment, water, and biota in and near a Superfund site. "Chemicals of Concern" are those that occur above a level where the maximum plausible exposure to the contaminated material might affect human health. This public health assessment addresses only those contaminants that the authors judge to be present at levels of concern. Levels of concern are listed as "comparison values" in relevant tables incorporated into this public health assessment. These values frequently differ from regulatory standards or health advisory levels. Subsequent sections of this public health assessment discuss whether chemicals of concern pose a potentially significant threat to public health.

A. Source of Contamination in Well No. 4

The Sta-Rite property on Wright street is identified as the apparent source of VOC contamination found in Well No. 4. Investigations at the Sta-Rite property indicate that contamination originates at Plant 2 [55]. A liquid sample taken from a sump at Plant 2 in December 1982 showed levels of TCE at 77 μg/L and PCE at 28 μg/L. Samples collected from solvent catch basins at Plant 1 in 1982 showed very high levels of VOCs. The sludge from one catch basin had TCE at 1,200,000 μg/L and PCE at 60,000 μg/L [61, TABLE 2-2]. A January 1984 report concluded that VOC concentrations in soils near the Plant 2 sump were high enough to impact nearby groundwater [42].

Sub-surface Soil at the Sta-Rite Property

Soil borings were performed at a number of locations on the Sta-Rite property and samples were analyzed for VOCs. Some soil borings were drilled into known and suspected release areas (Plant 2 sump and Plant 1 sump #15 drainage field).

Soils underneath a sump at Plant 2 were shown in December 1983 to be contaminated with TCE at 980,000 μg/kg and PCE at 280,000 μg/kg. The sump and contaminated soils at this location were excavated and removed in 1983 [61, P2.6]. Soil boring samples were collected in 1991 and 1992 from 16 locations at Plant 2, with 12 locations showing contamination. Soil samples from one location near the former sump (SB-2008) had the highest levels of PCE (greater than 50,000 μg/kg) and TCE (greater than 8,200 μg/kg).

A total of 15 different VOCs were detected in these 12 soil samples [61, TABLE 4-4]. At Plant 1 the highest TCE concentrations, found in soil borings in 1991 and 1992, were at the drainage field for former sump #15 (281 μg/kg) and active sump #8 (240 μg/kg). A number of Plant 1 sumps have been identified as known or suspected points of VOC disposal [61, TABLE 4-11]. The contamination found in soil boring samples is summarized in Table 3.

Groundwater at the Sta-Rite Property

Groundwater under the Sta-Rite property was shown to have elevated levels of TCE and PCE contamination, as described in Table 4. Groundwater contamination at Sta-Rite was evaluated, in part, by analysis of samples collected from monitoring and extraction wells during the 1991-92 Sta-Rite Remedial Investigation. Remediation activities at Sta-Rite included the removal of contaminated groundwater by seven extraction wells. This extracted groundwater is currently discharged into the Delavan municipal storm sewer system. Table 5 summarizes the level of TCE and PCE contamination in groundwater found in each Sta-Rite extraction well.

B. Groundwater Contamination in Delavan Municipal Wells

Recent analysis of untreated water samples from Wells No. 3 and No. 4 show TCE continues to be present at low levels. The possible sources of contamination found in Well No. 3 has not been determined. See Table 1 for selected well testing of Delavan municipal wells from 1982 to 1985. The background section and Table 2 summarizes the history of VOC contamination found in Delavan municipal Wells No. 3 and No. 4.

C. Other Delavan Groundwater Contamination

Information suggests groundwater contamination in Delavan could be more widely spread than previously suspected. Groundwater sampling from wells at Delavan locations, other than the Sta-Rite property, has found contamination by some of the same chemicals found in Wells No. 4 and No. 3. The source of this contamination is not clear. While no homes in the Delavan area are known to use contaminated water from private wells, three Delavan businesses have wells with low levels of VOCs. Further sampling activities are needed before an accurate picture can be drawn that depicts the full extent of groundwater contamination in Delavan.

Contaminated Groundwater Migrating from the Sta-Rite Property

With the exception of the immediate vicinity of Well No. 4, there have been only limited investigations to characterize groundwater contamination that might be migrating from the Sta-Rite property. Several contaminant plumes may be flowing away from the Sta-Rite property. Models describing groundwater contaminant plumes moving beyond the

Sta-Rite property were proposed, but none have been adequately verified by sampling. In a 1983 report, groundwater modeling described a potential for high levels of contaminated groundwater to flow away from the Sta-Rite property [41]. In 1990 a contractor reported that analytical data suggest two distinct plumes of contaminated groundwater flow from the Sta-Rite property [56, P4.7].

Groundwater monitoring data collected during the Sta-Rite Remedial Investigation shows contamination up to the furthest monitoring points located west-northwest of the Sta-Rite property [63, TABLE 4-5]. One monitoring well cluster (D-5 & D-6) [44, TABLE 6], located just south of the railroad right-of-way and across Wright street from at the Sta-Rite property, has shown VOC contamination (Table 6). In 1983 and 1984, samples from both wells in the cluster revealed elevated levels of VOCs (Wells D-5 and D-6 are cased at 30-50 and 100-110 feet respectively). Groundwater samples collected in 1991 found some of these VOCs, but only in the shallower D-5 and at lower levels than in 1983 and 1984. From 1991 to 1994, TCE was consistently found in D-5 at levels between 6 and 9 μg/L [45 TABLE 2].

Contamination was also found at another monitoring well and soil boring location (MW-1030 & SB-1030), which is approximately 1,100 feet northwest of the Sta-Rite property. TCE was detected twice (4 μg/L) in groundwater samples collected from this monitoring well. Sources other than Sta-Rite were suggested for some of this contamination [64, P5.16], yet these VOCs were also in groundwater at the Sta-Rite property, and plume modeling indicated the sampling point is probably in the path of contaminants migrating from the property [41]. Between 1991 and 1994, TCE was consistently detected in MW-1030, ranging between 3 and 57 μg/L, with the higher levels detected in during the last two years. In 1994 PCE was also measured in MW-1030 at 1.4 μg/L [45, TABLE 2]. In 1995, a water sample collected from a naturally flowing spring, located 3,500 feet west-northwest of the Sta-Rite property, was found to contain TCE at 6.5 μg/L [42].

While modeling of Sta-Rite plume migration concluded that contaminated groundwater flows into Comus Lake, no investigations have examined groundwater movement in the vicinity of Comus Lake to substantiate this model. Comus Lake is a reservoir on Turtle Creek, and Swan Creek enters Turtle Creek immediately below the Delavan dam. Groundwater movement south of Comus Lake could be to the west or southwest, which could direct contaminant plumes much further to the west than suggested by previous investigations. There may also be seasonal variations in groundwater flow near and around Comus Lake, which also could affect the location and movement of contaminant plumes.

Other Delavan-Area Groundwater Investigations

In addition to the Sta-Rite property, the Wisconsin DNR has investigated other sites in Delavan that are known or suspected to be contributing contamination to the environment, including groundwater (Figure 4). Some of these sites fall under jurisdiction of the DNR Environmental Repair Project (ERP) and the Leaking Underground Storage Tank (LUST) program. The DNR reports there are three ERP sites and nine LUST sites within Delavan. Groundwater contamination by VOCs was found at several of these sites and indicates that contamination in Delavan may be wide spread. While these LUST and ERP sites are apparently the source of petroleum-based groundwater contamination, the sources of VOC contamination at these sites have not been identified.

Delavan Environmental Repair Project (ERP) Sites

Two former oil bulk storage facilities, the old Mobil Oil bulk plant and the Standard Oil/Mudlaff Oil bulk plant, are located on Ann Street, approximately 3,500 feet west of Well No. 4 and 1,500 feet west of Well No. 3. Shallow monitoring wells were installed to evaluate local groundwater contamination by petroleum products that escaped from these storage facilities [34]. In addition to detecting petroleum products in these monitoring wells, the DNR reports that VOCs were also found in groundwater [73]. At the Mudlaff Oil site, 13 groundwater monitoring wells were installed on and around the property. At two wells located on an adjacent lot east of the site, PCE was found at 193 and 1,800 μg/L, and TCE was found at 45 and 42 μg/L. This adjacent lot was shown in the map of a 1992 DNR site visit memo to be the site of a previous Sta-Rite machine shop [34]. At the Standard Oil site TCE was detected in water samples from two wells at 86 and 990 μg/L [36].

The Jacobus Oil ERP site is located on Sunshine street, approximately 800 feet north of the Sta-Rite property. TCE was found in three shallow groundwater monitoring wells, with the highest reported level at 8.1 μg/L [36].

Delavan Leaking Underground Storage Tank (LUST) Sites

Groundwater was investigated at four of the nine known Delavan LUST sites to evaluate the extent of contamination by petroleum products [37]. In addition to measuring petroleum-product contamination of groundwater, VOCs were also detected in groundwater samples collected from three of these sites, with PCE found only in soils at the fourth site, (County Ford at 1234 East Geneva Street is approximately 1,800 feet southeast of Well No. 3 and 1,250 south of Well No. 4) [53].

The Holiday/Super America service station, 803 East Geneva Street, is located approximately 2,500 feet west-southwest of Well No. 4 and approximately 1,250 southwest of Well No. 3. Groundwater samples were collected twice from seven locations and analyzed for VOCs. VOCs were detected in samples from three upgradient locations. PCE was detected both times in samples from each location, with the lowest and highest levels at 3 and 18 μg/L, respectively. TCE was found only once and at only one location, at 1 μg/L. The 1991 remedial investigation report states that VOC contamination of groundwater under this LUST site may be from another source [68]. Another assessment reported that PCE and TCE contaminated groundwater at this site is "not derived from on-site sources" [62]

Campbell's Mobil, at 746 East Geneva Street, is across the street from the Holiday/Super America service station. Three monitoring wells were installed at this LUST site to evaluate groundwater contamination from gasoline. In addition to finding an assortment of gasoline-related products in groundwater, PCE was detected at 3 and 5 μg/L in the two upgradient monitoring wells. The Tank Removal Assessment report did not evaluate the possible sources of this VOC contamination [50].

The Delavan Mobil/Del-Mart Phillips 66 service station is located at 338 East Walworth Avenue, approximately 5,200 feet west-northwest of Well No. 4 and 3,500 feet west-northwest of Well No. 3. Investigations at this LUST site found petroleum products in groundwater and soils. Two rounds of groundwater samples were collected from each of three groundwater monitoring wells. PCE was detected at least once in each groundwater monitoring well (but was not found in a sample from the soil vapor extraction well). PCE was found in six of eight groundwater samples, with the highest level measured at 2.2 μg/L. A report written by the consulting hydrogeologist said "the uniformity of the levels [of PCE] suggest that it has been caused by an upgradient source" [8].

Private Drinking Water Investigations

Several efforts were mounted to identify private wells in the Delavan area that might be affected by contaminated groundwater. No Delavan area homes were found with drinking water wells that are contaminated with VOCs. One naturally flowing spring, located within city limits, was found to be contaminated with TCE and was subsequently closed. Wells at three Delavan businesses, located in Mound Road Industrial Park, are approximately 1,300 feet north of Sta-Rite and were found to be contaminated with TCE.

Outside Delavan City Limits

The DNR Southeast District Water Supply staff occasionally test private wells in the Delavan area for VOC contamination. There are 18 homes on Comus Drive, located approximately 3,000 feet north of the Sta-Rite property, that obtain their drinking water from private wells. In August 1994, the DNR collected water samples from two wells in this neighborhood and tested for VOCs. No contamination was detected in either well [39]. In July 1994, the DNR collected a water sample from one private well located one mile northwest of Delavan. No contamination was found at this well [38].

The DNR reported to DOH, in 1994, that three private wells located in the Mound Road Industrial Park (northeast of the City of Delavan and within the Town of Delavan) were contaminated with VOCs below levels of health concern. This industrial area is approximately 1,000 feet north of the Sta-Rite property. Two of these wells were contaminated with TCE at 2.6 and 4.5 μg/L. The levels of VOC contamination measured in these wells are a not health concern [43].

In June 1995, the DNR placed a public notice in two local newspapers in order to identify any previously unknown private wells, which then could be tested. Only one homeowner in the immediate Delavan area requested to have a well sampled. In July 1995, DOH collected a water sample from this private well, which is located on State Highway 11 and approximately 2,500 feet northeast of the Sta-Rite property. No detectable VOC contamination was found in this well [23].

Within Delavan City Limits

Surveys were conducted by the City of Delavan and Sta-Rite to identify private wells that could be drawing contaminated groundwater. A non-obligatory private well registration form was included in the November 1991 water bill sent to all City residents [60, P3.3]. The City of Delavan reported that no wells were identified as a result of this mailing [20].

In a separate effort, Sta-Rite had a notice stuffed into a free newspaper that was distributed to each Delavan household [60, P3.3]. The Sta-Rite survey targeted an area covering a corridor from the Sta-Rite property northwest to Comus Lake [60, FIGURE 3-3], and no new wells were identified in the targeted survey area [60, FIGURE 4-2]. Water samples were collected at least three times from one well (PW-1) and no contamination was detected [58, APPENDIX I] [43, P3.3].

Water from this well was reported to be exclusively used for a swimming pool. It was also reported that water from a second well located in the area targeted by Sta-Rite was not used for potable purposes and the owner did not allow a water sample

to be collected [60, P4.3]. An additional private well was previously identified in 1984 in an area west of the targeted area [43, P3.3], but there are no reports that a water sample was collected from this well, nor was the location of the well identified.

In April 1995, DOH collected a water sample from a naturally flowing spring located in Spring Grove Cemetery, within the City of Delavan and approximately 3,500 feet west-northwest of the Sta-Rite property. TCE was detected at 6.3 μg/L. The City of Delavan and the cemetery caretaker closed the spring during June 1995 [22].

D. Surface Water Contamination

There are three bodies of surface water in the vicinity of Delavan Well No. 4 that might previously or currently be affected by contamination coming from the Sta-Rite property. These are: the Swan Creek tributary below the storm sewer effluent discharge point; a five-acre pond directly southeast of Sta-Rite (Figure 4); and Comus Lake. Swan Creek sediments and surface water were found to contain low levels of VOCs. No contamination was found in surface water samples from Comus Lake. There has been no sampling of sediments or surface water from the five-acre pond located near the Sta-Rite property.

Storm Sewer Effluent

Since the late 1950's Sta-Rite has used several storm-water sewer systems to dispose of some of the excess waste water from their property. Before 1982 the Sta-Rite storm sewer discharged into an open drainage ditch system that disposed water into a marshy area south of Plant 2, which was connected to an overflow area west of Wright Street. Information is not available to estimate what contamination, if any, may have been present in the marshy area or the overflow area.

It is feasible that contaminants could have been carried in waste water and deposited onto this field. However, any VOCs present in this surface water likely would have evaporated quickly. The concentrations of some VOCs in extracted water were also found to be elevated, with the highest levels found in 1982 (TCE at 5,000 μg/L). Table 5 summarizes the levels of VOC contamination in water pumped from each of the seven extraction wells.

It is not known if other contaminants were present in the waste water received by these areas, but sampling in December 1982 suggests that this waste water contained other, non-VOC constituents. The earliest available analytical results of Sta-Rite storm sewer water discharge were reported in December 1982. While results showed the levels of heavy metals at "typical" concentrations, the laboratory reported the "strength

of...sanitary wastewater is considerable with elevated concentrations of...total phosphorous and Oil and Grease," which were entering the sewer line [45].

Surface Water from Storm Sewer Effluent

VOC contamination is present in surface water where the storm sewer becomes the Swan Creek tributary, at SS-2. Table 7 characterizes the relationship of TCE concentrations in water from Sta-Rite extraction wells and storm sewers. However there are apparently several sources of VOCs detected in samples collected from SS-2. A leaking underground storage tank site was found and removed from 803 E. Geneva Street. Remediation activities include the discharge of contaminated extraction water into the same storm sewer line. A number of VOCs, including TCE, have been detected in groundwater at this Geneva Street location [69].

A permit for the temporary discharge of contaminated groundwater from Sta-Rite and into the Delavan municipal storm sewer was approved by the Wisconsin DNR in 1989 for PCE and TCE at 865 μg/L, and 3,840 μg/L, respectively [31]. There are no reports that levels of PCE and TCE in grab samples exceeded these levels. This permit was renewed by the DNR effective October 1990, until July 1995. This new permit did not set discharge limits for these VOCs [31].

Sediments from Storm Sewer Effluent

Sediments at SS-2 are contaminated with VOCs. Three samples collected in 1991 revealed the presence of low-levels of eight VOCs, including trichloroethylene (the highest level 2 μg/kg), which was not at a level of health concern. Three sets of samples were collected at distances of six and twelve feet from the SS-2 opening [58, TABLE 5-1].

Ambient Air Releases from Storm Sewer Effluent

The Preliminary Public Health Assessment for Delavan Well No. 4, issued in 1989, identified volatilized contaminants from extracted water in the municipal sewer system as a potential human exposure pathway. This document recommended that "air be tested for VOCs that may be emitted from sewer water contaminated by extraction well water" [1]. The Sta-Rite Remedial Investigation evaluated the potential air releases of VOCs from extraction water. One air sample was collected at SS-2 in 1991 and did not contain any detectable levels of VOCs [58, P4.20]. No air samples were collected where extracted water enters the storm sewer system, nor from any points in the system before water reaches SS-2. This represents a data gap.

Calculations in the Sta-Rite Remedial Investigation Report estimated that 75 percent of extracted water VOC contaminants would volatilize between the point of entry into the storm sewer system and the outlet to the Swan Creek tributary, at SS-2 [63, P4.22], as supported by the sampling data presented in Table 7. However, the Sta-Rite Remedial Investigation Report did not fully evaluate the fate of the compounds volatilized within the storm sewer. The Remedial Investigation implies that volatilized VOCs are mixed with air in the sewer to such a degree that by the time it reaches SS-2 the concentration is too low to detect. Unfortunately no air samples were collected at or within access covers along the path of the sewer to verify these calculations and subsequent conclusions.

Surface Water Run-Off from Sta-Rite Property

In the past, spent solvents at Sta-Rite were reportedly released occasionally onto the ground at the southeast corner of the paved area, east of Plant 2 [61, P2.6]. VOC contamination present on the ground could have volatilized into the air, seeped into the ground, or run off the property with storm water. Surface water run-off probably carried some of these contaminants away from the property. Currently, contaminated surface runoff from Sta-Rite is not a concern because there is no evidence contaminated water is being released onto the ground [61, P2-10].

It is difficult to evaluate how storm water moved around and off the Sta-Rite property. Portions of the property were regraded in the past when Sta-Rite connected to the Delavan storm sewer in 1982. Contaminants present on the ground would have been carried by runoff into drainage ditches on the Sta-Rite property, including the drainage ways servicing the older storm sewer system. An earlier document described "storm runoff from a portion of the facility near Plant 2, not currently served by a storm sewer drain, discharges through a drainage ditch southeast of Plant 2 into a five-acre pond southeast of the Sta-Rite property [59, P4.24]." Given the volatile nature of VOCs, this contamination probably no longer exists on the surface of the existing drainage ways.

In 1991 and 1992 a number of soil borings were taken east of Plants 1 and 2, and in a former drainage way. Tests showed relatively low VOC concentrations. It was concluded in one report that this contamination was not expected to impact groundwater quality [61, P4.20]. However at one location (SB-1025) over 21 different contaminants were detected, more than any other soil boring sample. Runoff from the adjacent parking lot and driveway could account for some contamination found in certain samples.

An artificial pond, located less than 500 feet southeast of the Sta-Rite property, may have received contaminated run-off in the past. A review of aerial photographs indicate this catchment basin was created between in 1972 and 1975, during the construction of the nearby Highway 43 [46]. A drainage ditch, which empties into this pond, is located

immediately east of Plants 1 and 2. Contaminated storm water runoff may have flowed east, into this ditch, and ultimately entered the pond. Contaminated soils are present in some of the areas served by the drainage ditch. A soil sample collected from the 13-15 foot depth of a boring on the northern edge of the ditch (SB-1031) showed the presence of a number of VOCs, including TCE. There are no reports of water or sediment samples collected from this pond. If VOCs reached this pond, detectable levels would probably not have remained in the surface water for more than 30 days. The lack of surface water sampling from this pond represents a data gap.

Comus Lake

A 1984 report described groundwater modeling in the vicinity of the Sta-Rite property and Well No. 4. As a result of this modeling the report concluded that contaminated groundwater in the vicinity of Well No. 4 and the Sta-Rite property probably discharges into Comus Lake [43, P3.3], approximately 4,900 feet to the northwest. Ensuing investigations of groundwater in the immediate vicinity of Well No. 4 and Sta-Rite also come to this conclusion. Consequently, two surface water samples were collected from the lake in June 1983, and analyzed for two VOCs (including TCE). Neither contaminant was detected [43, P3.3]. No other surface water sampling of this lake has been reported.

E. Toxic Chemical Release Inventory

A Toxic Chemical Release Inventory (TRI) search was conducted by the Division of Health for the City of Delavan zip code (53115). The TRI is used to investigate any other sources of the same type of environmental contamination as found at the Superfund site. Certain manufacturers are required to report to the U.S. EPA of releases to the environment of over 300 hazardous chemicals. This reported information is entered into the automated TRI system. The TRI was searched for reports of releases for the years 1989, 1990, and 1991. The search reported releases of one VOC by Sta-Rite Industries, which was not identified as a contaminant of concern. Concentrations of this VOC in nearby air was estimated using a plume dispersion model with the highest reported annual release level. The model indicated that this VOC released from Sta-Rite does not pose an apparent health concern to nearby residents.

F. Quality Assurance and Quality Control

The Wisconsin Division of Health assumes the DNR, the City of Delavan, Sta-Rite Industries, and all contractors fully met standard sampling protocol, unless stated otherwise, including those cited as appendices in referenced reports. These quality assurance and quality control measures were to be followed during the field sampling and measurements, the chain of custody activities, laboratory analytical procedures, and data reporting. The ability of the Division of Health to make valid conclusions depends on the amount and quality of data provided.

G. Physical and Other Hazards

There are no apparent physical hazards associated with Delavan Well No. 4.

PATHWAYS ANALYSES

City of Delavan residents were evidently exposed in the past to contaminated water originating from Delavan Well No. 4. The Delavan municipal water supply system is an indeterminate past public health hazard because a lack of information does not allow confident estimates of past human exposure. The presence of VOC-contaminated groundwater at several Delavan locations suggests that contamination may be widespread and area residents who obtain their drinking water from private wells may be exposed. The private wells at three Delavan businesses are contaminated with low levels of VOCs that are not a health concern. Several investigations have not discovered any homes in the Delavan area that use private wells and draw VOC-contaminated groundwater.

People may be exposed to VOC-contaminated surface water and sediments where storm sewer effluent enters Swan Creek, but detected levels were not a health concern. Contaminated air released from storm sewer effluent is an indeterminate public health hazard. The Preliminary Health Assessment for Delavan Well No. 4 recommended testing of air for contamination released from extracted water disposed into the storm sewer, which comes out at Swan Creek. Testing was only conducted outside of one disposal point. Surface water and sediment samples were not collected from a five-acre pond located just south of the Sta-Rite property. This is a data gap.

The following discussion describes how people may become exposed to site-related contaminants. There are several ways people are exposed to contamination from a site. "Completed Exposure Pathways" are those pathways where there are indications people were exposed to contaminants from the site and sufficient information exists to evaluate such an exposure. All five of the pathway elements must exist for there to be a "Completed Exposure Pathway" (a description of these five elements is found in Appendix C). This considers exposures that likely occurred in the past and exposures that are currently occurring. A "Potential Completed Pathway" is when there is insufficient information to link a contaminant or chemical to a known level of exposure among an identified population. This is an exposure that may have occurred in the past, is possibly occurring, or which may occur in the future. An exposure pathway can be eliminated from consideration if at least one of the five elements is missing and will never be present.

A. Completed Human Exposure Pathways

Public Water Users

Delavan municipal water is an indeterminate public health hazard in the past because, while municipal water was contaminated in the past, there are no data about contaminant concentrations in tap water. People who used municipal water provided by the City of Delavan in the past were apparently exposed to VOC contaminants. Contaminated water was first found in Well No. 4 in 1982, and in Well No. 3 in 1983. Though the City of Delavan discontinued using water from Well No. 4 in July 1982, it is not known when the well first began drawing contaminated water, and what levels of contaminants were present. The City of Delavan continued to use water from Well No. 3 after discovering low levels of VOCs because contamination was sporadic and, when detected, usually at levels below the groundwater standards. Contaminants were probably present in Well No. 4 prior to 1982. It is likely that the contaminants present before 1982 were the same VOCs found in post-1982 testing, but information is not available to determine contaminant concentrations in tap water.

Starting in June 1993, VOC contamination was removed from water entering in the Delavan water supply. This was a result of the new water treatment facility that the City of Delavan brought on-line at that time.

It is not known when Delavan Well No. 4 first began drawing VOC-contaminated water originating from the Sta-Rite property, but available information suggests the well may have become contaminated between 1968 and 1970. Well No. 4 first began operating in 1968 [33]. Sta-Rite Industries reported TCE was used at Plant 1 as a paint thinner and degreaser from 1960 to 1977 [66], and the use of TCE for cleaning and degreasing occurred at Plant 2 from 1968 till 1977 [56, P4.1]. Solvents were released to the ground at Sta-Rite via floor drains, catch basins, and sumps, starting in the early to mid 1960's. Regional groundwater flow in the vicinity of Well No. 4 is to the northwest and estimated to be between 135 and 500 feet per year [59, P4.18] [55, P22]. The velocity of groundwater flow increases the closer it comes to the well because of the gradient caused by the drawing of water into the well [58, P4.18]. Well No. 4 is approximately 500 feet from the contaminated area at Sta-Rite Plant 2. Given this distance, the estimated flow rates, and assuming that the contamination in Well No. 4 came exclusively from Plant 2 (as suggested by the Sta-Rite Remedial Investigation), it is reasonable that VOC contamination from Sta-Rite first reached Well No. 4 between 1968 and 1970. However, Plant 1 could have contributed to the contamination detected in Well No. 4. Investigations on Sta-Rite property conclude that groundwater contamination originating at Plant 1 does not reach Well No. 4. If it is assumed that only contaminated groundwater from Plant 2 affected Well No. 4, then the well may have drawn contaminated groundwater during 1968.

It is not possible to confidently estimate contaminant concentrations in tap water arriving at Delavan homes and businesses between 1982 and 1993. There are no reports of tap water samples collected from any residences or business in Delavan. Water samples were collected from taps at two schools and the Delavan City Hall [52], but no contamination was reported. Further complicating this issue, the Delavan water supply system does not uniformly mix water from all municipal wells before distribution.

In 1991 and 1992 water samples were collected from two distribution points located near Well No. 4, and the Delavan central treatment plant (located near Well No. 3). These results are presented in Table 8 and the sampling locations are shown in Figure 4. These data show a relationship between the levels of contamination in water at on-line municipal wells and that found in nearby distribution points. This probably reflects contaminant concentrations found in nearby taps. The concentration of contaminants in water arriving at each Delavan tap is probably affected by a number of factors, including: the concentration of contamination in each operating well; the proximity to each operating well; proximity of each tap to reservoirs; relative pumping rates of each well on a given time and date; the relative degree of water use in the distribution network; and sizes of distribution pipes serving the tap.

The worse-case average contaminant concentrations in tap water can be estimated by extrapolating concentrations observed in 1982 and 1983 to levels in the past. The levels of contaminants in Well No. 4 remained stable for the first two years following detection (Table 1). The decrease in contaminant levels after 1983 could be attributed to any of a number of actions, including: increased pumping of Well No. 3; decreased pumping of Well No. 4; removal of contaminant sources; or movement downgradient of higher pockets of one or more groundwater contaminant plumes. Consequently, prior to 1982 the levels of contamination may have been lower, higher, or the same as that found during 1982 and 1983. Therefore, using the middle range, the highest monthly level for each VOC contaminant detected in Well No. 4 in 1982 and 1983 were averaged to derive the following estimated pre-1982 concentrations. The estimated worse-case average concentrations for tetrachloroethylene (PCE) and trichloroethylene (TCE) are 33 μg/L and 244 μg/L, respectively.

Even if these worse-case concentrations accurately reflect past levels of contaminants in Well No. 4, the discussion above describes the pitfalls of estimating contaminant concentrations in Delavan residential tap water. Despite this, it might be useful to create a worse-case scenario of the highest potential human exposure to contaminants in residential tap water. This scenario could use the middle range, worst-case concentrations and assume that water from Well No. 4 received very little mixing, and the number of Delavan residents receiving undiluted water from Well No. 4 was equal to the proportion of water provided by that well.

As reported above, in 1981 Well No. 4 pumped an average of 12 million gallons per month, approximately 58 percent of the City of Delavan's municipal water needs. The number of Delavan municipal water users in 1981 was estimated to be 4,200. Using this approach, an estimated 2,440 (58% of 4,200) Delavan residents were possibly exposed between 1968 and 1982 to VOC contaminated water from Well No. 4. These users of contaminated, municipal water probably ingested VOCs when drinking contaminated water, inhaled VOC vapors released from domestic use of contaminated water, and absorbed TCE through their skin while bathing and washing in contaminated water.

It is apparent that Delavan residents were exposed to contaminated municipal water prior to 1982. However, the lack of information about contaminant concentrations in tap water does not permit confident estimates of past levels of human exposure. Consequently, the Delavan municipal water supply system is an indeterminate public health hazard before 1982.

B. Potential Human Exposure Pathways

Private Wells

People who live within or near the City of Delavan and obtain their drinking water from private wells may be exposed to groundwater contaminated with VOCs. Private wells at three businesses within the Town of Delavan were found to be contaminated. However, several investigations have not discovered any Delavan area households that use contaminated well water.

Since 1982, three private wells within the City of Delavan have been identified in the area presumed to be in the path of contaminant plume(s) flowing from the Sta-Rite property. Two of the wells were not reported to be used for human consumption purposes; a water sample collected from one of these wells did not reveal contamination. Information is not available about the use or testing of the third well.

Samples were also collected from several private wells located within Delavan city limits and in the immediate vicinity. All private wells used by homes were found to be uncontaminated. Three wells used by businesses in an industrial park just beyond the northeastern corner of Delavan, located less than 1,000 feet north of Sta-Rite property, were contaminated with low levels of VOCs that are not a health concern, including TCE at 2.6 and 4.5 μg/L.

Surface Water

Surface Water from Storm Sewer Effluent

Surface water is contaminated where the Delavan storm sewer empties into the Swan Creek tributary, at SS-2 (Figure 4). However, these contaminants in surface water are not at levels of potential health concern.

Surface Water Run-off from Sta-Rite

In the past contaminants were present in Sta-Rite storm sewer water and on the surface of the ground at Sta-Rite. Surface water run-off probably carried some of these contaminants off the Sta-Rite property. Some of this contamination may have reached an artificial pond, located 1,000 feet southeast of the Sta-Rite property and constructed between 1972 and 1975. There are no reports of surface water samples collected from this pond, which represents a data gap.

Public use of this pond is not discouraged as the City of Delavan has made public access improvements northwest of the pond. While there are no reports of people swimming at the pond, people are fishing here.

Comus Lake Surface Water

Surface water samples were collected from Comus Lake and no contamination was detected. Surface water at Comus Lake does not represent a potential or completed human exposure pathway.

Sediment

Sediment from Storm Sewer Effluent

Sediments are contaminated with VOCs where the Delavan storm sewer empties into the Swan Creek tributary at SS-2. However, these concentrations of contaminants in the sediment are not at levels of health concern.

Sediment from Sta-Rite Run-off

In the past, contaminants were present in Sta-Rite storm sewer water and on the surface of the ground at Sta-Rite. Surface water run-off probably carried some of these contaminants off the Sta-Rite property. Some of this contamination may have reached an artificial pond southeast of the Sta-Rite property. There are no reports of surface water or sediment samples collected from this pond, which is a data gap. If VOCs reached this pond, detectable levels would probably not have

remained in the sediment for more than 30 days. While there are no reports of people swimming here, people are evidently fishing at this pond.

Contaminated Air Released from Storm Sewers

The Preliminary Public Health Assessment for Delavan Well No. 4 identified volatilized contaminants from extraction well water in the municipal sewer system as a potential human exposure pathway and recommended that "air be tested for VOCs that may be emitted from sewer water contaminated by extraction well water" [1]. The Sta-Rite Remedial Investigation evaluated the potential air releases of VOCs from extraction well water [63]. The report estimated that most of the contaminants present in extracted water would volatilize before leaving the storm sewer; however, the investigation report did not fully evaluate the fate of these volatilized compounds. No air samples were collected at access covers along the path of the sewer to verify these calculations and conclusions, which is a data gap.

VOC-contaminated air released from storm sewers is an indeterminate public health hazard. The lack of data does not permit an adequate evaluation to determine people are exposed to VOC-contaminated air from the Delavan storm sewer.

PUBLIC HEALTH IMPLICATIONS

Low levels of VOC contamination measured in water provided by Delavan Well No. 4 between 1983 and 1993 does not represent a public health hazard. A review of reported health data did not show an unexpected number of cancers or birth defects among Delavan residents.

A. Toxicological Evaluation

Tetrachloroethylene (PCE)

Delavan residents who used municipal water were evidently exposed in the past to water contaminated with tetrachloroethylene (PCE), though the degree of their exposure is not known. Delavan residents who obtain some or all of their water from private wells may have a current and past exposure to water contaminated with PCE, but none of these private wells have been tested for contamination. People who use PCE-contaminated water probably ingest PCE when drinking contaminated water, inhale PCE vapors released by the domestic use (cooking and showering) of contaminated water, and absorb PCE through their skin while bathing and washing in contaminated water.

Tetrachloroethylene was consistently found in Well No. 4 water samples collected from March 1982 to December 1983. The highest level detected was 97 μg/L, and, during

this period, the average of monthly peak levels was 33 μg/L. After 1983 PCE has been detected less frequently in Well No. 4, and at much lower levels (see Table 1 and Table 2).

Delavan residents were probably not exposed to PCE during the time Well No. 4 was disconnected, from 1983 to 1990. When Well No. 4 was brought back on-line in 1990, PCE was occasionally detected, but never above 1 μg/L. PCE has never been found in water samples collected from Well No. 3. Therefore, since 1982 the exposure of Delavan residents to PCE is not an apparent public health hazard.

Before 1982 the levels of PCE in Well No. 4 are unknown because no water samples were collected and analyzed for VOCs. A worse-case would be to assume that 33 μg/L is representative of PCE concentrations in Well No. 4 prior to 1982. A worse-case scenario estimates that PCE may have been present at this level in Well No. 4 for 12 years, from 1970 till 1982 (see page 22 for a further discussion). Using this scenario, past exposure from PCE possibly posed "no apparent increased cancer risk"" [4, P47] to people who used municipal water provided by Delavan Well No. 4. The highest level of PCE detected in Well No. 4 (97 μg/L) is not expected to cause any other adverse, non-cancer health effects from a long-term exposure.

EPA formerly categorized PCE as a probable human carcinogen, but this classification is currently being re-evaluated. The Wisconsin Department of Health and Family Services is aware that PCE may reasonably be anticipated to be determined a carcinogen because it causes cancer in laboratory animals. Some studies have suggested a potential relationship between exposure to PCE and some forms of cancer, but these human and laboratory animal studies are inconclusive [3, P60]. There is no empirical evidence proving PCE causes cancer in humans. Studies of laboratory mice have shown increases in liver cancer when exposed to much higher levels of PCE than what was detected in Delavan Well No. 4 (386 mg/kg/day or the drinking water equivalent of 13,510 mg/L) [3, P28]. Assuming PCE is a carcinogen, a person would have "no apparent increased risk" [4, P47] of cancer if they were exposed for 12 years to drinking water contaminated with PCE at a level of 33 μg/L. Refer to Appendix D for cancer risk estimation methods.

Trichloroethylene (TCE)

Many of Delavan residents apparently drank water contaminated with trichloroethylene (TCE), but the level of their exposure is unknown. Delavan residents who obtain some or all of their water from private wells might have a current and past exposure to water contaminated with TCE. Delavan residents who use TCE-contaminated water probably ingest TCE from drinking contaminated water, inhale TCE vapors released from cooking and showering with contaminated water, and absorb TCE through their skin while bathing and washing in the contaminated water.

Trichloroethylene was found in 88 of 91 water samples collected from Well No. 4 over the period of March 1982 to December 1985. The City of Delavan halted the use of Well No. 4 in July 1982. The highest levels of TCE observed in Well No. 4 were between March 1982 and December 1983, with the highest level of 1,300 μg/L. The average of monthly peak level of TCE over this period was 244 μg/L. Low levels of TCE continue to be regularly found in untreated water from Well No. 4. In 1991 TCE was found in 64 of 65 water samples collected from Well No. 4, with the range of concentrations between 1 and 7 μg/L (Table 2).

Initially, TCE-contaminated water in the Delavan water supply came exclusively from Well No. 4. But in June 1983, one year after halting the use Well No. 4, low levels of TCE were detected in water from Well No. 3. Between June 1983 and December 1985 TCE was found in 32 of 53 water samples collected from Well No. 3. The highest TCE concentration detected was 230 μg/L, though other peak monthly levels during this period were between 16 and 2 μg/L. The levels of TCE in Well No. 4 before March 1982 are not known because no water samples were collected. See Table 1 and Table 2 for a summary of TCE levels in Delavan Wells No. 3 and No. 4.

Delavan residents were exposed to low levels of TCE from 1983 to 1990, when Well No. 4 was disconnected from the municipal water system. After this time, all of their TCE exposure came from Well No. 3. During this time, the highest level of TCE detected in Well No. 3 was 230 μg/L, though tests of many samples collected during this time did not detect TCE. If TCE was detected it was typically between 2 and 20 μg/L. When Well No. 4 was brought back on-line in 1990, TCE was usually detected, yet never above 7 μg/L. There are no known adverse health effects from exposure to TCE at such levels. Consequently, between 1982 and the present, there are no adverse health effects expected to occur from exposure to water from the Delavan municipal water supply system.

The levels of TCE in Well No. 4 before March 1982 are unknown because no water samples were previously collected and analyzed for VOCs. The worse-case would be to assume that 244 μg/L is representative of TCE concentrations in Well No. 4 prior to 1982. Such a scenario estimates 244 μg/L as the average concentration present in Well No. 4 for 12 years, from 1970 till 1982 (refer to page 22 for a further discussion). Using this scenario, such a past exposure to TCE probably posed a "no apparent increased cancer risk" [4, P47] to people who used municipal water provided by Delavan Well No. 4. The highest level of TCE detected in Well No. 4 (1,300 μg/L) is not expected to result in any adverse, non-cancer health effects in people.

The EPA formerly categorized TCE as probable human carcinogen, but this classification is currently being re-evaluated. There is no definitive evidence that shows TCE causes cancer in humans, but some studies suggest higher concentrations of the chemical may cause cancer in laboratory animals. Two recent studies indicate that

exposure to water contaminated with TCE might be associated with congenital cardiac malformations. In one study, infants of mothers exposed during the first trimester of pregnancy to TCE-contaminated water were significantly more likely to have a congenital heart disease than did infants whose mothers did not have a similar exposure [49]. Another study examined rats for a dose-dependent relation between fetal exposure to TCE and various congenital cardiac defects and a possible relationship was noted [16]. An increase in liver cancer was found in laboratory mice when exposed to a high level of TCE (the drinking water equivalent of 35,000 mg/L), but the results are not conclusive [2, P27]. If it is assumed TCE is a carcinogen, as previously defined, a person would have "no increased" risk of cancer if they were exposed for 12 years to drinking water contaminated with TCE at a level of 244 μg/L. Refer to Appendix D for cancer risk estimation methods.

B. Health Outcome Data Evaluation

A review of health outcome data is appropriate when there is evidence that people living near a Superfund site have been exposed to contaminants at levels that might plausibly lead to an increase in rates of death or disease. "Health Outcome Data" refers to records of death and/or illness. A review also may be appropriate if there are reports of unusual clusters of disease near the site or due to specific community health concerns. As discussed previously in the *Pathways Analyses* section, Delavan residents have apparently been exposed to contaminated water pumped by Well No. 4., though it is unclear if residents were exposed to contaminant levels which were at levels of health concern. The Wisconsin Department of Health and Family Services, Division of Health, is not aware of any reports of clusters of chronic disease or cancers in the vicinity of this site.

The Wisconsin Division of Health requested data from the Wisconsin Cancer Reporting System for reported cases of specific cancers diagnosed in people who described Delavan as their zip code of residence. These data were obtained for the period of 1980 to 1991 reporting the occurrence of liver cancers, kidney cancers, bladder cancers, cancers of the urinary tract, and leukemias. The incidence rate was calculated for each of these reported cancers and none were above expected levels. Additionally, birth certificate data were searched for Delavan births for the period 1968 to 1989. A record of each birth certificate was flagged and pulled based on the occurrence of any reported birth defect. There were no apparent birth defects clusters, and the number of reported birth defects were not above expected levels.

C. Community Health Concerns Evaluation

No community health concerns pertaining to Delavan Well No. 4 have been received by the Division of Health or the Walworth County Nursing Service agency.

CONCLUSIONS

- Delavan municipal water is currently safe to drink. Low levels of VOCs were found in water drawn by Delavan municipal wells, from 1983 till 1993, but this contamination did not represent an apparent public health hazard. A treatment system was installed in 1993 and is effective at removing VOCs from water pumped by Wells No. 3 and No. 4.

- Delavan Well No. 4 is an indeterminate public health hazard because of exposures prior to 1983. Delavan residents were probably exposed to VOC-contaminated groundwater for a number of years before 1982, but there are no data available prior to this date.

- Contaminated groundwater is not an apparent public health hazard for Delavan area residents who obtain their drinking water from private wells. No Delavan-area households were identified that obtain their drinking water from VOC-contaminated private wells. The wells of three Delavan businesses are contaminated with VOCs, but the levels found in these wells are not a health concern.

- Groundwater is contaminated in the Delavan area, but the vertical and horizontal extent of groundwater contamination in and around the City of Delavan has not been adequately characterized. The presence of VOCs in groundwater samples from locations around Delavan suggests that contamination may be widely spread. The lack of information about the extent of groundwater contamination in the Delavan area makes it difficult to completely evaluate potential human exposures to contaminated private well water.

- Ambient air from storm sewer water is an indeterminate public health hazard to Delavan residents who live in the vicinity of the storm sewers. Water in storm sewers serving Sta-Rite contain VOCs, and air within the storm sewers may also contain VOC vapors. Because air sampling was not conducted inside the storm sewer or at access covers where the sewer passes through Delavan, it is not possible to estimate possible human exposures to such ambient air releases.

- Sediments in the Swan Creek tributary have been tested for VOCs and are not a health concern.

- Surface water and sediments in the five-acre pond, located immediately south of the Sta-Rite property, have not been tested for contamination. This is a data gap.

RECOMMENDATIONS

- The geographical limits of contaminated groundwater in the Delavan area should be accurately determined. The vertical and horizontal extent of contaminated groundwater, including that flowing from the Sta-Rite property, should be fully characterized.

- Until the full extent of groundwater contamination is determined, any existing private wells discovered within and near the City of Delavan should be evaluated or tested for VOC contamination. Any new private wells installed in the Delavan area should also be evaluated or tested for VOC contamination. The City of Delavan should consider well head protection zones for wells that provide water for the municipal water supply system.

- Ambient air monitoring should be performed inside and around storm sewer access covers to characterize potential releases of VOCs.

- Surface water and sediments of the five-acre pond, located immediately adjacent and south of the Sta-Rite property, should be tested for contamination.

A. Need For Follow-up Health Activities

The ATSDR Health Activities Recommendations Panel (HARP) and the Wisconsin Division of Health evaluated the data on this site to determine what needs exist for additional research and/or local education about health related concerns. Such activities could include further studies on cases of disease in the vicinity of the site or providing residents with additional information about the health effects of exposures to specific toxic chemicals coming from the site. HARP recommends ongoing community health education activities to ensure that Delavan area residents are aware of groundwater contamination.

B. Public Health Action

The following actions either have been or will be performed to meet the needs expressed by the recommendations of this public health assessment. The Wisconsin Division of Health, in cooperation with ATSDR, will:

1. Continue to consult with the Wisconsin DNR and the U.S. EPA on public health issues that may arise as any action(s) on the site occur;

2. Provide continuing health education as new information becomes available concerning public health issues related to the site;

3. Continue to solicit the health concerns of citizens of the City of Delavan, directly or through the Wisconsin DNR, the Walworth County Public Health Nursing Service agency, and through public meetings;

4. Continue to cooperate with the Wisconsin DNR and Walworth County Public Health Nursing Service agency to address environmental health and public health issues that pertain to the site and the community;

5. Offer professional education opportunities about the site to practicing health care providers in the City of Delavan and nearby areas.

TABLES

TABLE 1: Municipal Well Contamination
Selected Samples: 1982 to 1985
City of Delavan, Wisconsin
All Concentrations in Micrograms per Liter (μg/L)

WELL DESIGNATION AND CHEMICALS DETECTED	MAR 1982	SEP 1982	DEC 1982	MAR 1983	JUN 1983	AUG 1983	DEC 1983	MAR 1984	JUN 1984	SEP 1984	NOV 1984	MAR 1985	Comparison Value (μg/L)
WELL No. 3													
Tetrachloroethylene (PCE)	NT	-	-	-	-	-	-	-	-	-	-	-	0.2[a]
Trichloroethylene (TCE)	NT	-	-	-	11*	230*	5*	-	-	15*	18*	2	3.2[a]
WELL No. 4													
Tetrachloroethylene (PCE)	16*	NT	37*	15*	22*	39*	28*	-	-	-	-	-	0.2[a]
Trichloroethylene (TCE)	130*	130*	165*	270*	150*	1,300*	120*	27*	17*	40*	16*	3	3.2[a]

* Exceeds or matches Comparison Value.
\- Not Detected.
NT Sample Not Taken/Chemical Not Tested in Sample

a. Oral CREG (Cancer Risk Evaluation Guideline) for 1×10^{-6} excess lifetime cancer risk.

TABLE 2: Municipal Well Contamination - 1982 to 1991
City of Delavan, Wisconsin
All Values in Micrograms per Liter (μg/L)

YEAR TESTED & CONTAMINANT DETECTED	WELL NO. 4			WELL NO. 3			Comparison Value[a] (μg/L)
	Lowest Level Detected	Highest Level Detected	Frequency of Detection	Lowest Level Detected	Highest Level Detected	Frequency of Detection	
1982							
Tetrachloroethylene	12*	37*	6/6	-	-	0/1	0.2
Trichloroethylene	60*	170*	9/9	-	-	0/3	3.2
1983							
Tetrachloroethylene	9*	96*	41/54	-	-	0/35	0.2
Trichloroethylene	13*	1,300*	54/55	1	230*	22/35	3.2
1984							
Tetrachloroethylene	2*	24*	5/10	-	-	0/8	0.2
Trichloroethylene	7*	40*	14/14	5*	18*	5/12	3.2
1985							
Tetrachloroethylene			NT			NT	0.2
Trichloroethylene	3	22*	11/13	2	20*	5/11	3.2
1986							
Tetrachloroethylene	-	13*	1/1			NT	0.2
Trichloroethylene	4*	7*	2/6	-	8*	1/7	3.2
1987							
Tetrachloroethylene			NT			NT	0.2
Trichloroethylene	1	17*	11/20	4*	16*	2/16	3.2
1988							
Tetrachloroethylene	1*	4*	13/41	-	-	0/10	0.2
Trichloroethylene	1	9*	44/49	1	2	4/11	3.2
1989							
Tetrachloroethylene	1*	2*	27/54	-	-	0/13	0.2
Trichloroethylene	1	5*	47/54	1	2	12/15	3.2
1990							
Tetrachloroethylene	1*	1*	4/17	-	-	0/2	0.2
Trichloroethylene	1	4*	20/41	1	2	7/8	3.2
1991							
Tetrachloroethylene			NT			NT	0.2
Trichloroethylene	1	7*	64/65	2	4*	9/10	3.2

* Matches or Exceeds Comparison Value.
NT: Contaminant Not Tested for in Collected Sample(s).
a. Oral CREG (Cancer Risk Evaluation Guideline) for $1x10^{-6}$ excess lifetime cancer risk.

Source: Simon Hydro-Search, Technical Memorandum/Report Appendix J.1. Volume II. Remedial Investigation/Feasibility Study. Prepared for Sta-Rite Industries, Inc. Brookfield, Wisconsin: Simon Hydro-Search. July 17, 1992.

TABLE 3: VOC Contamination in Soil Borings
from Sta-Rite Industries, Inc.
Adjacent to Delavan Well No. 4
Delavan, Wisconsin
August 1991 through April 1992
All Concentrations in μg/kg

CHEMICAL	Minimum Detected (μg/kg)	Maximum Detected (μg/kg)	Frequency of Detection
Tetrachloroethylene (PCE)	2	>50,000	15/28
Trichloroethylene (TCE)	1	>8,200	26/28

Source: Simon Hydro-Search. Technical Memorandum #1 - Source Characterization. Prepared for Sta-Rite Industries, Inc. Contract SF-90-02. Tables 4-4 & 4-11. Brookfield, Wisconsin: Simon Hydro-Search. October 29, 1992.

TABLE 4: Groundwater Contamination
on Property of Sta-Rite Industries, Inc.
Adjacent to Delavan Well No. 4
Delavan, Wisconsin
October 1991 through January 1992
All Concentrations in μg/L

CHEMICAL	MONITORING WELLS			EXTRACTION WELLS			Comparison Value[a] (μg/L)
	Minimum Detected (μg/L)	Maximum Detected (μg/L)	Frequency of Detection	Minimum Detected (μg/L)	Maximum Detected (μg/L)	Frequency of Detection	
Tetrachloroethylene (PCE)	1*	32*	10/24	8*	44*	2/9	0.2
Trichloroethylene (TCE)	1	1,700*	18/24	1	500*	8/9	3.2

* Exceeds Comparison Value
a. Oral CREG (Cancer Risk Evaluation Guideline) for $1x10^{-6}$ excess lifetime cancer risk.

Source: Simon Hydro-Search, Technical Memorandum #4 - Contaminant Extent Characterization. Tables 4-4 and 4-9. Prepared for Sta-Rite Industries, Inc. Contract SF-90-02. Brookfield, Wisconsin: Simon Hydro-Search. January 18, 1993.

TABLE 5: Groundwater Extraction Well Contaminants
Sta-Rite Industries
1984 to 1991
City of Delavan, Wisconsin
All Values in Micrograms per Liter (μg/L)

STA-RITE EXTRACTION WELL	Lowest Level Detected	Highest Level Detected	Frequency of Detection
WELL NO. 1			
Tetrachloroethylene	6	670	11/33
Trichloroethylene	11	5,800	32/33
WELL NO. 2			
Tetrachloroethylene	-	10	1/32
Trichloroethylene	120	3,480	11/32
WELL NO. 3			
Tetrachloroethylene	-	-	0/32
Trichloroethylene	10	9,400	14/32
WELL NO. 4			
Tetrachloroethylene	-	-	0/32
Trichloroethylene	5	9,200	11/32
WELL NO. 5			
Tetrachloroethylene	-	-	0/12
Trichloroethylene	-	21	1/12
WELL NO. 6			
Tetrachloroethylene	-	-	0/12
Trichloroethylene	-	130	1/12
WELL NO. 7			
Tetrachloroethylene	33	790	10/22
Trichloroethylene	36	21,029	21/22

Source: Simon Hydro-Search. Technical Memorandum/Report Appendices, Remedial Investigation/Feasibility Study. Table 4-4, Appendix J.2, Monitoring Well Water Quality Data. Prepared for Sta-Rite Industries, Inc. Contract SF-90-02. Brookfield, Wisconsin: Simon Hydro-Search. July 17, 1992.

TABLE 6: Groundwater Contamination
D-5 & D-6 Monitoring Well Cluster
City of Delavan, Wisconsin
All Concentrations in Micrograms per Liter (μg/L)

CHEMICAL	WELL D-5†			WELL D-6†			Comparison Value[a] (μg/L)
	1983	1984	1991	1983	1984	1991	
Tetrachloroethylene (PCE)	10*	-	-	-	-	-	0.2
Trichloroethylene (TCE)	588*	670*	8*	4*	6*	-	3.2

* Exceeds or matches Comparison Value.
\- Not Detected.
† Well D-5 is draws water from a depth of 30-50 feet and D-6 is draws water from a depth of 100-110 feet.
a. Oral CREG (Cancer Risk Evaluation Guideline) for $1x10^{-6}$ excess lifetime cancer risk.

Source: Simon Hydro-Search, Technical Memorandum/Report Appendices. Appendix J.2, Volumes II. Remedial Investigation/Feasibility Study. Prepared for Sta-Rite Industries, Inc. Brookfield, Wisconsin: Simon Hydro-Search. July 17, 1992.

TABLE 7: Trichloroethylene Concentrations
Simultaneous Water Samples - 1982 to 1991
Sta-Rite Extraction Wells & Municipal Storm Sewers
City of Delavan, Wisconsin
All Concentrations in Micrograms per Liter (μg/L)

WELL/SAMPLE DESIGNATION	NOV 1982	NOV 1984	DEC 1984	SEP 1985	APR 1986	SEP 1986	JUN 1988	NOV 1988	JUN 1989	MAR 1990	SEP 1990	NOV 1991	DEC 1991
Extraction Well 1	n/a	4,700	2,900	580	110	140	35	273	115	26	14	20	15
Extraction Well 2	n/a	3,480	0	1,000	0	620	320	-	131	0	0	210	268
Extraction Well 3	n/a	2,300	0	210	0	140	57	152	47	0	0	14	10
Extraction Well 4	n/a	170	0	47	0	26	9	-	9	-	2	0	1
Extraction Well 5	n/a	21	190	-	-	-	-	9	0	-	-	0	1
Extraction Well 6	n/a	-	-	-	-	-	-	-	0	-	-	0	0
Extraction Well 7	n/a	n/a	n/a	900	-	3,300	2,400	5,310	685	108	52	350	241
Outfall 001	5,000	-	-	-	16	19	2	-	-	1	-	1	3
SS-1	-	-	-	-	-	-	-	-	39	22	21	21	-
SS-2	-	82	120	220	100	38	24	14	9	2	0	5	5

\- Sample Not Collected
n/a Sample not available: Well not constructed.

TABLE 8: Trichloroethylene Concentrations - 1991 & 1992
Municipal Wells and Water Supply Distribution Points
City of Delavan, Wisconsin
All values in Micrograms per Liter (μg/L)

Sampling Date	Well No. 3	Well No. 4	825 E. Geneva.	1441 E. Wisconsin
7/01/91	3	4	2	2
8/12/91	2	3	1	1
9/09/91	-	2†	-	-
12/16/91	4	4	4	4
11/11/91	4	3	3	3
10/07/91	4	4	2	3
1/20/92	4	2	2	3
3/09/92	3†	3†	-	-

- Trichloroethylene not detected in sample.
† Water pumped from well not used by Delavan water supply system.
Source: Gabriel - Midwest, Ltd., laboratory reports submitted to the City of Delavan.

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APPENDIX A: Figures

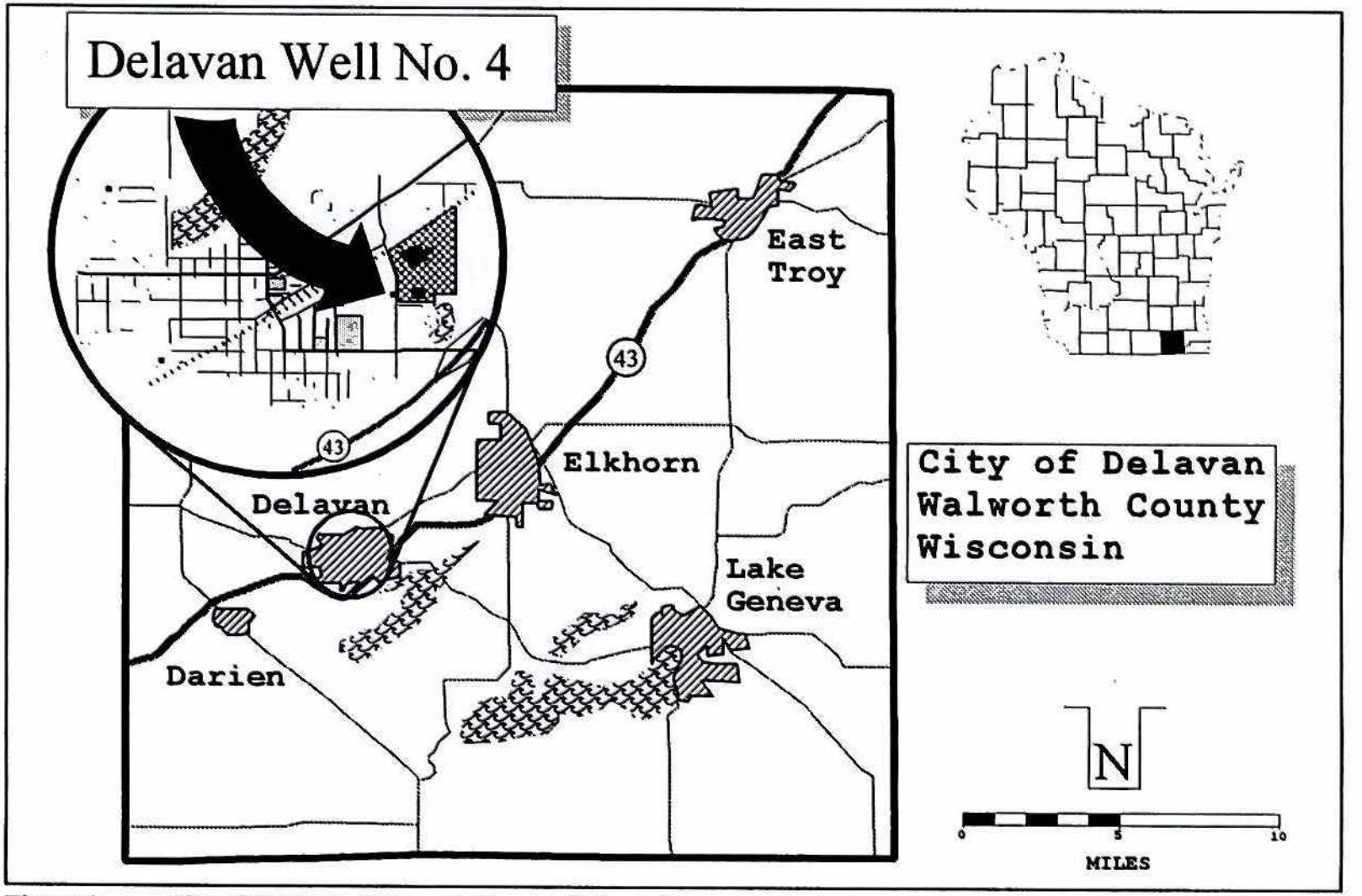


Figure 1: City of Delavan, Walworth County, Wisconsin.

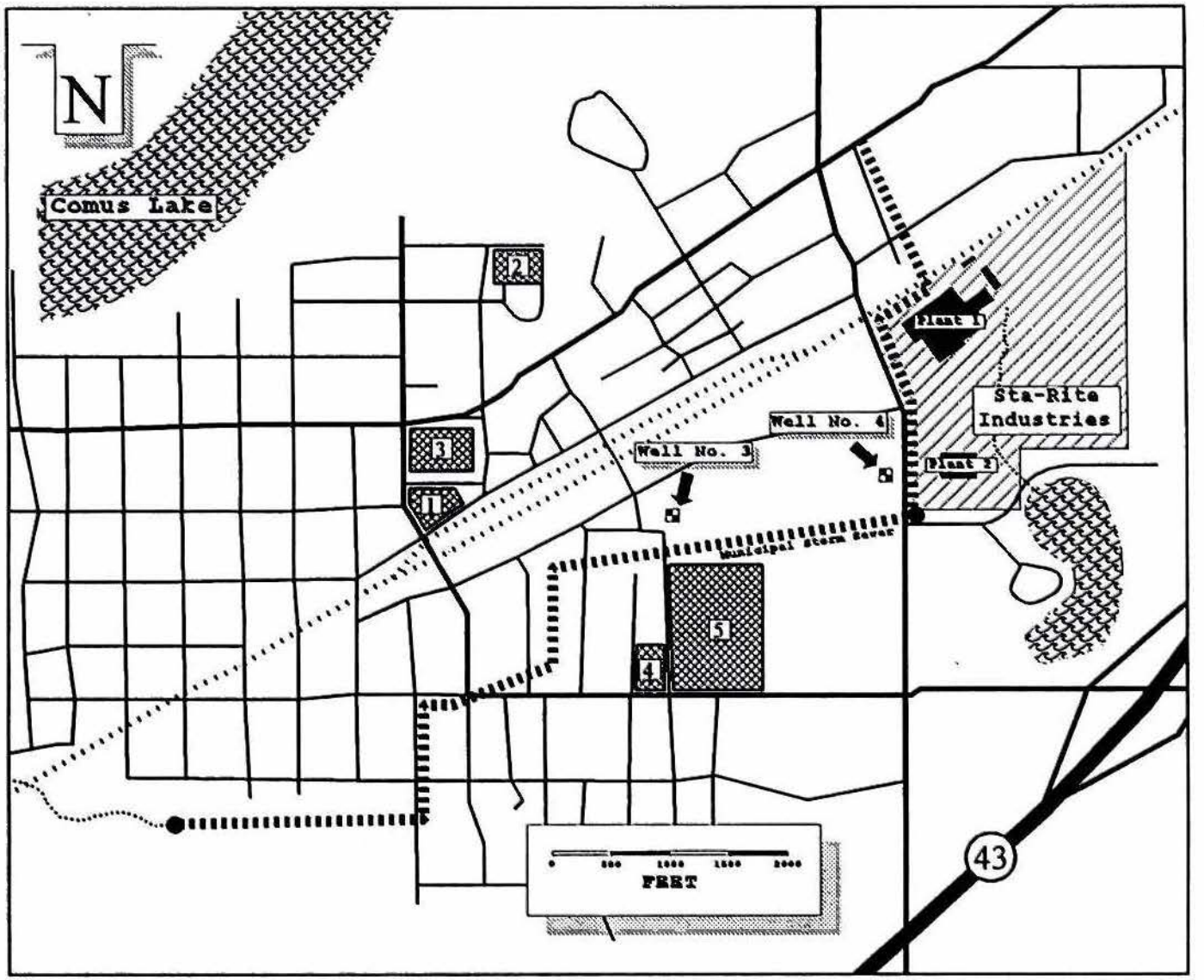
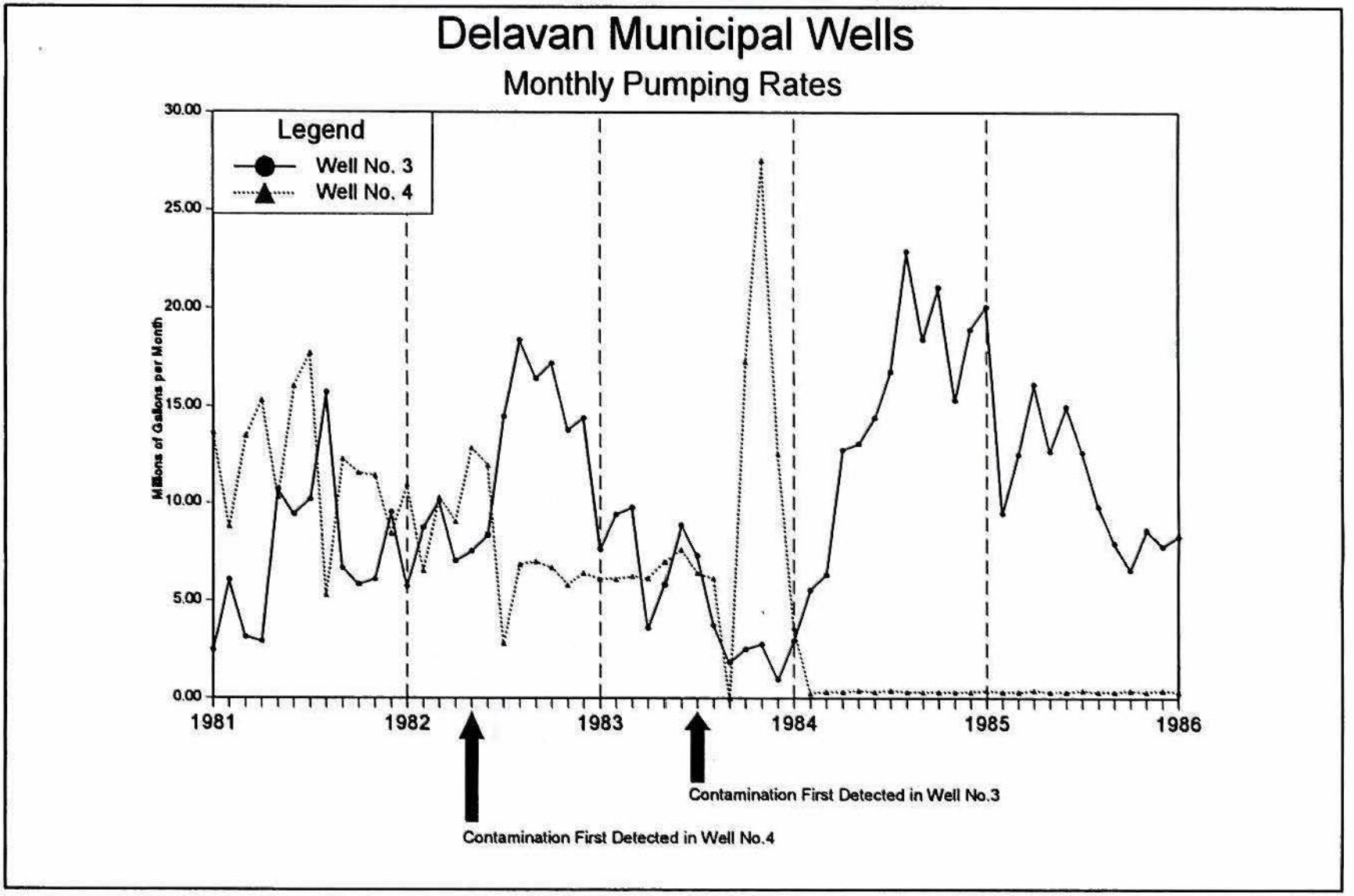


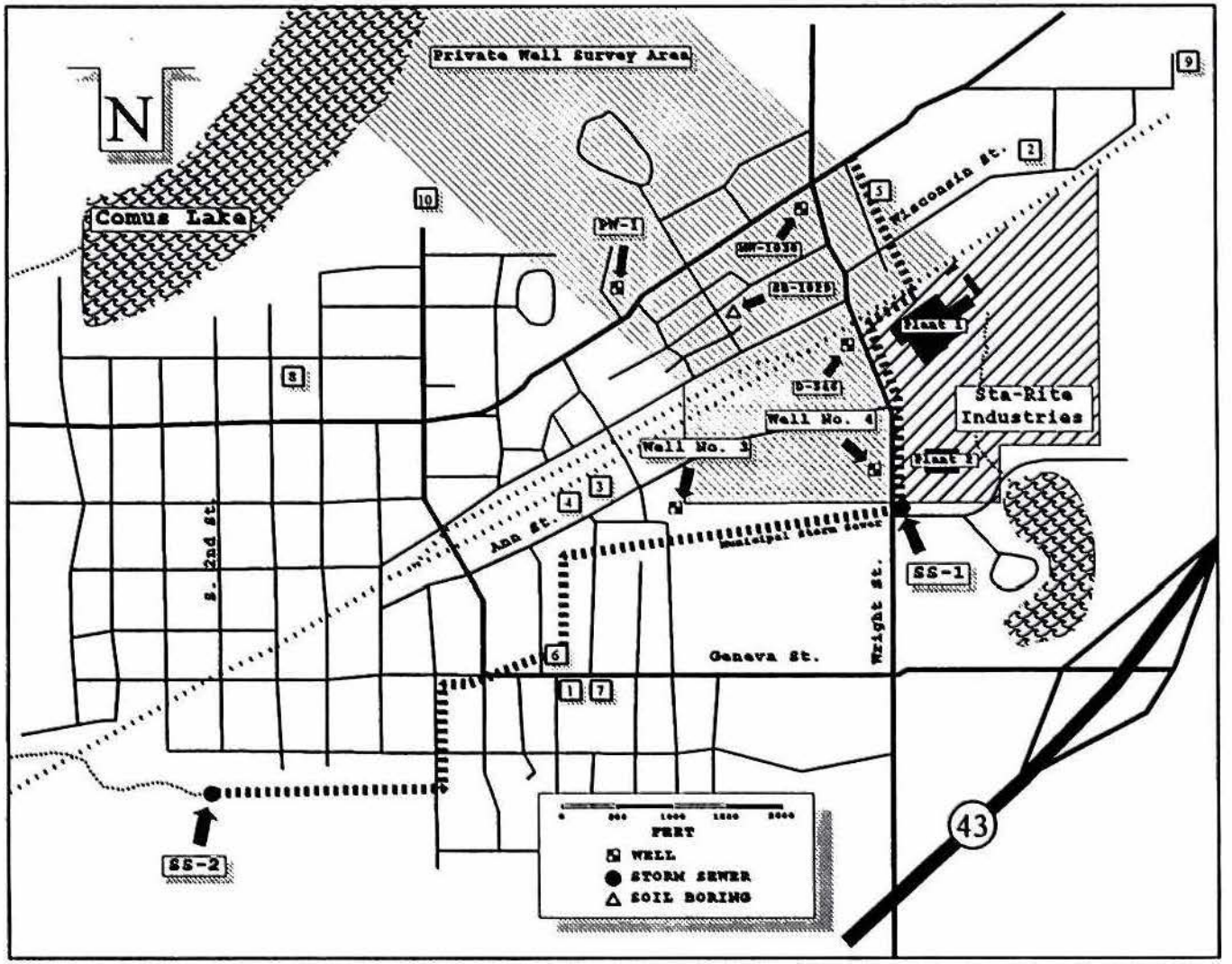
Figure 2: Wells No. 3 and No. 4, City of Delavan, Wisconsin.

Potentially Sensitive Populations

1. Day Care Center
2. Private Elementary School
3. Private School
4. Nursing Home
5. Public Elementary School



Eigure 3: Monthly Pumping Rates of Delavan Wells No. 3 and No. 4.



Eigure 4: City of Delavan, Wisconsin.

Points of Interest:

1. Geneva Street Water Main Sampling Point.
2. Wisconsin Street Water Main Sampling Point.
3. Standard/Mudlaf Oil ERP Site.
4. Former Mobil Oil Bulk Storage ERP Site.
5. Jacobus Oil ERP Site
6. Mobil Service Station UST Site.
7. Holiday Service Station UST Site.
8. Delavan Mobil Service Station UST Site.
9. Jeninga Brothers and Frontier Building Private Wells.
10. Spring at Spring Grove Cemetery.

APPENDIX B: Definitions

ATSDR: The Agency for Toxic Substance Disease Registry, a federal agency.

Cancer Risk Evaluation Guide (CREG):
A concentration of a carcinogen in a media (water, soil, or air) at which excess cancer risk is not likely to exceed one case of cancer in one million persons exposed over a lifetime.

Cancer Slope Factor (CSF):
The upper limit on the lifetime probability (at or less than 1 in 1,000,000) that a cancer causing chemical will cause cancer at a dose of 1.0 mg/kg/day.

Carcinogen: A substance which has been proven to cause or is suspected of causing cancer in humans or animals.

CERCLA: The Comprehensive Environmental Response, Compensation, and Environmental Liability Act. Also known as "Superfund", this program is administered by the U.S. Environmental Protection Agency.

DOH: Division of Health, Wisconsin Department of Health & Social Services.

DNR: Wisconsin Department of Natural Resources

Groundwater Enforcement Standards (and Preventive Action Limit Standards):
Health-based groundwater goals set by the Wisconsin DNR that when exceeded prompt regulatory action. Established under the Wisconsin Statute for Groundwater Quality, Chapter NR-140.

mg/kg/day: Milligrams per Kilograms per Day

mg/kg: Milligrams per Kilogram (soil concentration measurement)

National Priorities List (NPL):
U.S. EPA's list of top priority hazardous waste sites that are eligible for investigation and cleanup under Superfund.

PCE: Tetrachloroethylene or Perchloroethylene.

PPB: Parts Per Billion or Micrograms per Liter (μg/L or μg/kg).

PPM: Parts Per Million or Milligrams per Liter (mg/L or mg/kg).

Remedial Investigation and Feasibility Study (RI/FS):
Two parts of the Superfund process. The Remedial Investigation includes the collection and evaluation of data to define site conditions, including the nature of hazardous substances found at a site and the extent that those hazardous substances were released from the site. These releases are evaluated to assess the effect on public health and the environment. The Feasibility Study defines a range of likely alternatives for cleaning up a site.

SVOC: Semi-Volatile Organic Compounds

TCE: Trichloroethylene.

U.S. EPA: United States Environmental Protection Agency

μg/L: Micrograms per Liter or Parts Per Billion (water concentration measurement)

VOC: Volatile Organic Compounds

APPENDIX C: Pathways Evaluation

Pathways are evaluated to determine whether nearby residents have been exposed to contaminants originating from the site. A pathway is a route along which contaminants can move away from a site and enter the bodies of people living nearby. There are five elements in a completed pathway:

1) Contaminant Source: The place where contaminants entering the environment are coming from.
2) Media: a media that the contamination is found in (soil, sediment, groundwater, air, surface water, fish, and game animals).
3) Exposure Point: the location at which human contact is made with the contamination. The Exposure Point is specific to each type of media (e.g. - groundwater, surface water, soil, etc.)
4) Exposure Route: the process by which the contaminated media gets inside of people (eating/drinking, skin/dermal contact, or inhaling).
5) Receptor Population: groups of people who are or may be exposed.

APPENDIX D: Toxicological Evaluation - Cancer Risk Estimation Methods

In estimating lifetime excess cancer risk, the following formula [4, P47] is used:

annual exposure dose (mg/kg/day) × cancer slope factor (mg/kg/day)$^{-1}$ × exposure factor in years

The result of calculating a cancer risk estimate from this formula is then applied to the following table to quantify the risk estimate:

Quantitative Risk	Qualitative Risk Interpretation
$1x10^{-6}$	"insignificant or no increased risk"
$1x10^{-5}$	"no apparent increased risk"
$1x10^{-4}$	"low increased risk"
$1x10^{-3}$	"moderate increased risk"
$1x10^{-2}$	"high increased risk"
$1x10^{-1}$	"very high increased risk"

Tetrachloroethylene

No apparent increased risk of cancer from a 12-year exposure to the average estimated PCE level found in Delavan Well No. 4 (page 26): Assuming that tetrachloroethylene (PCE) is a carcinogen, as previously determined by the U.S. EPA, and the cancer screening value is used (Cancer Slope Factor [5.1E-02] is 0.69 μg/l), this 1:1,000,000 risk level was exceeded by all the levels detected in Well No. 4. Assuming the combined exposure of all three routes (dermal, ingestion, and inhalation) is three times that expected from drinking water alone, this combines to create a total PCE exposure equivalent to 99 μg/L, and converts to 3.0 μg/kg/day or 0.003 mg/kg/day (70 kg adult drinking 2 liters of water per day). Excess cancer risk is estimated based on an adult being exposed to the cancer causing substance for a lifetime, or 70 years. This estimation assumes that Delavan residents were exposed to PCE for a period no longer than 12 years. Using the U.S. EPA's former cancer slope factor it is estimated that a person exposed to drinking water contaminated at 33 μg/l for 12 years would have "no apparent increased risk" of cancer ([0.003 x 5.1E-02 x 12/70] = [1.53E-04 x 12/70] = 2.6E-05). There are no other known health effects from ingesting the highest level of PCE detected in Delavan Well No. 4.

Trichloroethylene

No apparent increased risk of cancer from a 12-year exposure to the average estimated TCE level found in Delavan Well No. 4 (page 27): Assuming trichloroethylene (TCE)

is a carcinogen, as previously defined by the U.S. EPA, and a Cancer Slope Factor of 1.1E-02, this value was exceeded by most levels detected in Well No. 4. Combined ingestion, inhalation and dermal exposures would then total an equivalent TCE exposure of 732 μg/L. This converts to 20.9 μg/kg/day or 0.0209 mg/kg/day (70 kg adult drinking 2 liters of water per day). Excess cancer risk is estimated based on an adult being exposed to the cancer causing substance for a lifetime, or 70 years. This estimation assumes that Delavan residents were exposed to TCE for a period no longer than 12 years. Using the slope factor it is estimated a person drinking water contaminated at 244 μg/l for 12 years would have "no apparent increased risk" of cancer ([0.0209 x 1.1E-02 x 12/70] = [2.3E-04 x 12/70] = 3.9E-05.

APPENDIX E: Response to Public Comments

1. *"The health assessment report is out of scope. The report covers beyond the "site" [Well No. 4]. Other health concerns may exist due to other releases unrelated to this project, however, the purpose from my understanding of this report is to verify the health concerns of the Superfund Site. The geology and hydrogeology should be left to people in those sciences. The Superfund Site is Well No. 4, not all of the groundwater aquifers of Delavan."*

   A public health assessment is the evaluation of data and information on the release of hazardous substances into the environment in order to assess any past, current or future impact on public health. To fully assess the impact of hazardous substances on people who live near a hazardous waste site, public health assessments must evaluate a total environmental exposure to site-related substances. Therefore, public health assessments examine potential human exposure to site-related hazardous substances within a media that may have multiple sources, including possible nearby sources not technically defined as "Well No. 4."

   Groundwater contamination by chlorinated volatile organic compounds has been found at many contiguous locations in the Delavan area. This public health assessment examines all available environmental sampling data in order to provide citizens with an accurate evaluation of the human health implications of this groundwater contamination.

   A multidisciplinary team participates in the preparation and review each public health assessment. Each participant brings specific environmental health expertise to the team. The following specialists were involved with the preparation and review of this public health assessment: epidemiologist, environmental engineer, environmental health specialist, toxicologist, health educator, chemist, and hydrogeologist.

2. *"The report also seems to follow its own path and not the table of contents. Background information should be presented in background information section and not redundantly throughout the report. Background information should be the largest section of the report. The type face for sections under background are not consistent. It appears that the sub,sub-sections Sta-Rite, Investigations and Follow-up Activities should be their own section. The report should have a Remedial Action Section."*

   Public health assessments, including the format of the report, follow clear training and guidance criteria set forth under the "Public Health Assessment Guidance Manual"[5], and subsequent guidance documents provided to preparers by the

Agency for Toxic Substances and Disease Registry, under the U.S. Public Health Service.

3. *If the Health Department felt that there were "data gaps," the Health Department should have collected samples to fill the gaps. The Health Department came out to sample private wells, why not then sample the points where the Health Department feels data would have been so valuable.*

   In preparing the public health assessment reports, the Wisconsin Department of Health and Family Services (DHFS) relies on environmental sampling data collected by the U.S. Environmental Protection Agency, the Wisconsin Department of Natural Resources, and potentially responsible parties and their contractors. The public health assessment presents recommendations, which may include the need for additional data that would provide a clearer picture of the extent of contamination and potential human exposures. When additional sampling is needed to fill data gaps, DHFS will communicate the need for additional sampling efforts with one of these agencies. However, DHFS does not typically collect environmental samples for analysis unless there is a concern that a contaminated media may pose a health hazard to the public. In Delavan, DHFS worked closely with DNR to ensure that private wells were sampled. Many of the private wells were tested by DNR. DHFS staff collected a sample from a private well as requested by a citizen.

4. *The report states that five VOCs were found in Well No. 4, list them. Do not leave the reader guessing, for instance, when a reference was made to a sample where more than 13 compounds were detected. If references are made to analytical data and compounds detected, the compounds and level of detection should be listed, as to not leave the reader guessing to the level of detection.*

   Public health assessments examine the potential human health issues of contaminants in the environment. While a myriad of hazardous substances are found in media on and around a site, only those substance which might pose a possible human health hazard are evaluated in-depth within a public health assessment. The report may indicate that other unspecific chemicals were present at a site (either substances that are hazardous or those at such levels not known to pose a human health hazard), but the report is prepared to minimize burdening readers with the details of substances that are clearly not a health hazard. This information is included in the report to indicate to the reader that these data are available. Interested readers can obtain more detailed, chemical-specific information from the source document, the preparer of the report, or the information repository on Well No. 4 at the public library in Delavan.

5. *The author says the vertical and horizontal extent of the plume has not been defined and leads the reader this think that Sta-Rite and the DNR are not addressing the*

problem. The vertical and horizontal extent of the plume has been defined. A clear case hydrogeologically has been made to demonstrate that Plant 1 is hydraulically isolated from the influence of Well No. 4. In addition chemically, the contamination from the two plants has its own distinct finger print. [Contamination at] Plant 2 matches with [contaminants found in] Municipal Well No. 4.

Sta-Rite-initiated environmental investigations of contamination off the Sta-Rite property have primarily focused on impacts to Well No. 4. These investigations have not proven that Well No. 4 captures all contaminated groundwater migrating away from Sta-Rite Plant 2. Sampling of groundwater from monitoring wells on Ann Street and west of Well No. 4 shows impacts from some of the same contaminants found in the municipal well and at the Sta-Rite property. It should be noted that groundwater modeling suggests these monitoring wells may be sidegradient, not downgradient from the Sta-Rite property. Unfortunately, a groundwater sampling program was not implemented to test this model and aid with the complete characterization of contaminated groundwater moving away from the Sta-Rite Plant 2.

While groundwater contamination beneath Sta-Rite Plant 1 may be hydraulically isolated from Well No. 4, there is a contaminant plume migrating away from this area of the Sta-Rite property and the extent of this plume has not been determined. Furthermore, it has not been determined if there is a downgradient merging of the contaminant plumes flowing from Plant 1 and Plant 2.

Piecing together a clear picture of contaminated groundwater in the Delavan area is further confounded by the detection of site-related contaminants in many groundwater monitoring locations, including those which are apparently upgradient from Sta-Rite. The full extent of contaminated groundwater beneath and near Delavan has not been determined.

6. *The author makes reference to the Delavan School for the Deaf. Since when has the handicap of being deaf increased the sensitivity to contaminated groundwater?*

Many students at the School for the Deaf were reported to have multiple handicaps and related health problems [19]. Some studies report that people with pre-existing health problems may be more susceptible to the effects of certain substances. People with compromised kidney or liver functions may have an increased risk of the toxic effects of TCE or PCE since the liver serves as the primary site of PCE and TCE metabolysis, with their metabolites excreted through the kidney [2][3].

CERTIFICATION

This Delavan Well No. 4 Public Health Assessment was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Gail D. Godfrey
Technical Project Officer
Superfund Site Assessment Branch (SSAB)
Division of Health Assessment and Consultation (DHAC)
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with its findings.

Richard E. Gillig
Chief, SPS, SSAB, DHAC, ATSDR